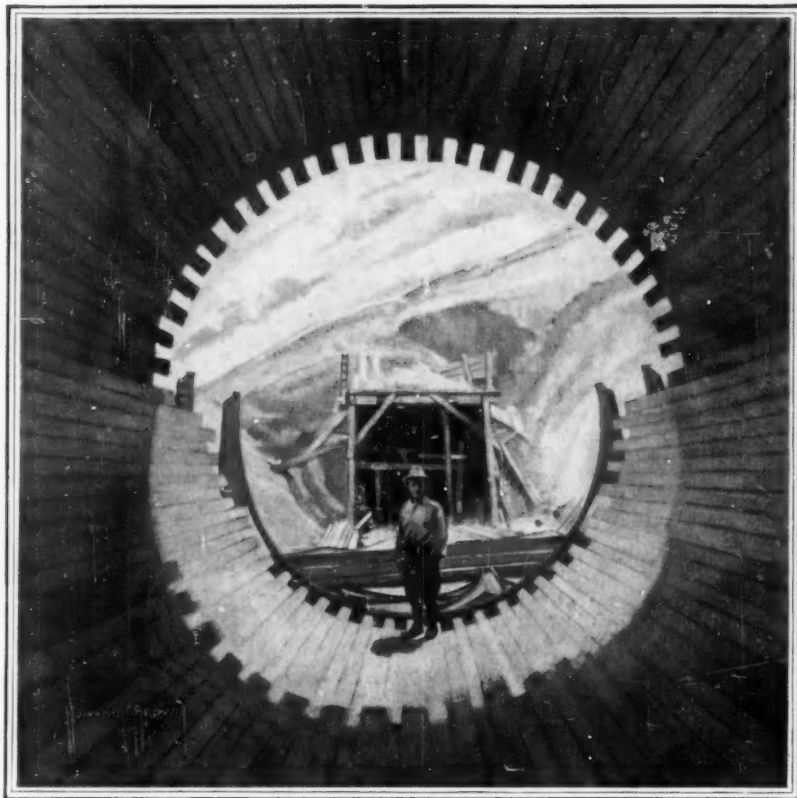


# SCIENTIFIC AMERICAN

December 1928



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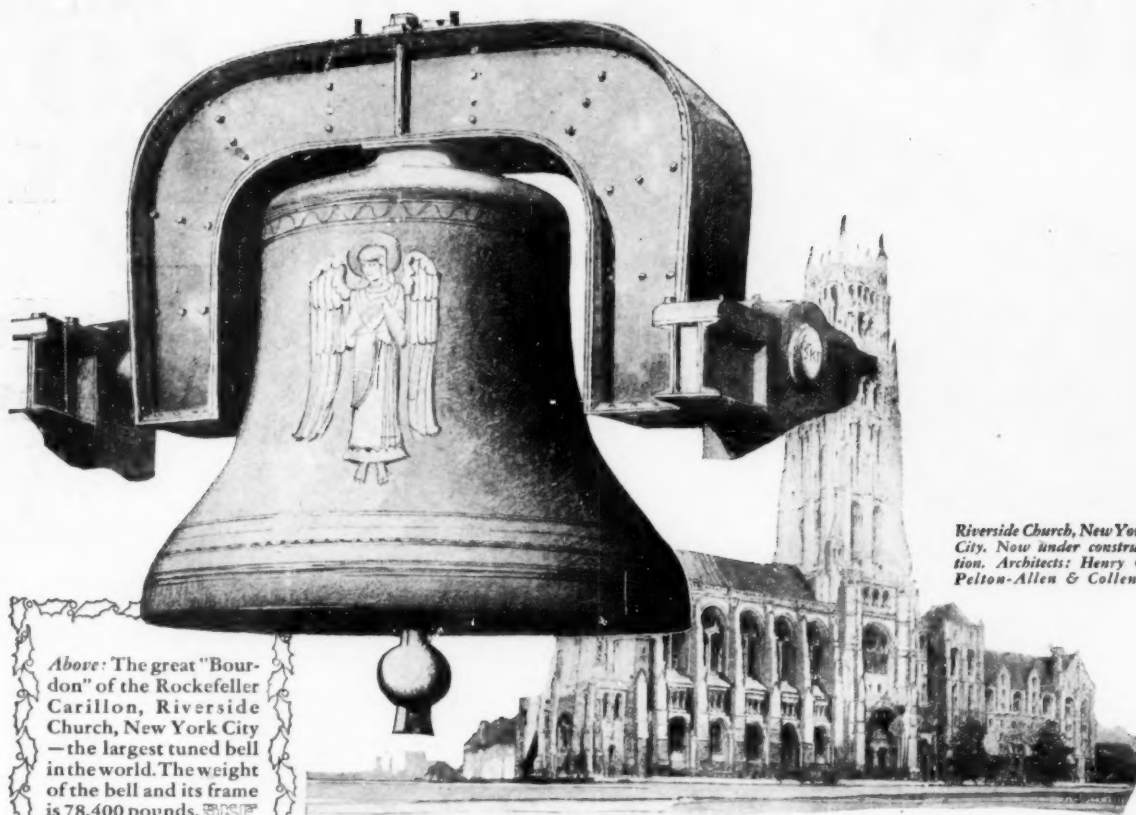
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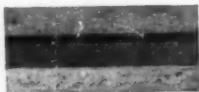
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perfect  
gift**



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# SCIENTIFIC AMERICAN

24 WEST 40th STREET

NEW YORK CITY

December 1928

Edited by ORSON D. MUNN

Eighty-fourth Year

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### COVER

This month Howard V. Brown, our cover artist, has achieved a striking effect in illustrating a continuous stave wooden pipe line under construction at the point where it is about to enter a tunnel. The article which this painting illustrates begins on page 504.

**FACTORY  
ENTRANCE  
NO  
ADMITTANCE**



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*Tapered*  
**ROLLER BEARINGS**



# Looking Ahead With the Editor

## Automobiles

**D**URING January at the annual Automobile Show in New York City the public will see for the first time the latest models of American cars. Apropos of the occasion, the January issue of *SCIENTIFIC AMERICAN* will contain a wide variety of automobile material which was released to us in advance for this purpose. Besides details of the new cars, this issue will include many items of great interest to car owners and others.

## Eruptive Mountains

**P**ROBABLY you do not realize that there are 66 active volcanoes in the world today. It's true. An article soon to be published describes some of the more famous of these, gives their histories, and tells how they have often upset the theories of volcanologists. Many interesting facts concerning their periods of inactivity, their eccentricities, and the materials they eject, are brought out in this study of a most fascinating subject.

## Paper

**I**T has been said often that should some great cataclysm obliterate our civilization, future races would find but few records on which to base an estimate of our culture. We moderns use wood-pulp paper that rapidly deteriorates, whereas the ancients used clay and stone and the medieval scholars used parchment and rag paper, all of which last centuries. A forthcoming article about paper is well illustrated with photographs to show the decay of very new records.

## What is Life?

**A**MATEUR chemists can duplicate the experiments performed by Professor Herrera and described in an article coming soon. Fascinating pseudo-cells, made of common chemical substances by him, display the non-living features of protoplasm. As a result of his studies of imitation cells, Professor Herrera believes that life is no phenomenon but a property which all matter possesses under the right conditions.

## Do Animals Think?

**B**IOLOGISTS say "No." They use "spontaneity," "inherited propensity," and "mechanical automata" as words to explain the apparent cerebrations of animals. The author of an article on hand opposes these views. He believes that animals do think and cites examples in support of his theories. Frankly, no one knows definitely who is right but the discussion is an intensely interesting one and you will enjoy reading it.

## Every Issue Fully Illustrated

**M**en are known by the magazines they read. What easier road to distinction could there be than reading the *SCIENTIFIC AMERICAN*—at four dollars a year?

# Among Our Contributors

## Alexander F. Skutch



Dr. Skutch, who contributes in this issue a very interesting article on the carnivorous plant called the bladderwort, is of the younger school of botanists of Johns Hopkins University. He has just completed a study of the anatomy of the banana, and expects to spend a year, during the period of the fellowship recently awarded him by Johns Hopkins University, in Central America engaged in a scientific study of the development of the banana leaf.

## Earl E. Schumacher

Mr. Schumacher is a member of the technical staff of the famed Bell Telephone Laboratories in New York where many scientists work on a multitude of problems in pure and applied science. His work there has pertained to new alloys for cable sheathing, alloys for vacuum tubes, thermionic activity, and other very interesting problems.

## Paul Griswold Howes

Mr. Howes is an assistant curator of a museum in Connecticut but he is the sort of man who is not satisfied unless he is exploring in his pet spot. In his case it is Dominica which he says he discovered "scientifically."



On his own resources he has already made two fruitful trips there and now plans another. Scientifically exact in his methods, he includes in his articles a great deal that savors of romantic adventure.

## E. L. Ch'canot

From the versatile pen of Mr. Chicanot has come many fine studies of the economics of Canada. His article in this issue, concerning the future of the great northwestern territory above our border, will open the eyes of many as to the economic possibilities there.

## James Henry Breasted

Professor Breasted has devoted most of his time since his early college days to the study of oriental languages and literature, has taught Egyptology and oriental subjects in American Universities, and has written much on these subjects. He is the Director of the famous Oriental Institute.

# WESTERN INDUSTRIAL LEADERSHIP

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and Tubes*

*Motion Pictures*

*Wearing Apparel*

*Furniture*

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Machine Products*

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Ornamental Iron*

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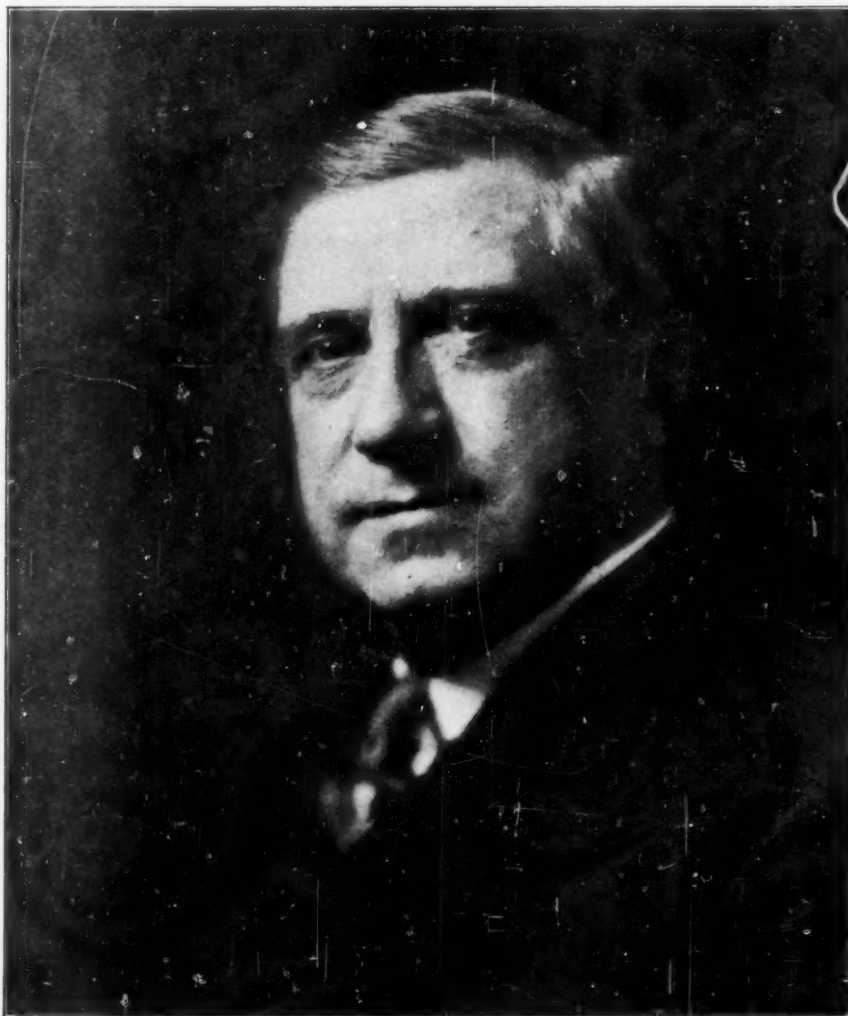
Write Business Agent, giving all available data.

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City of Los Angeles

Los Angeles offers these advantages to industry:—Mild Climate—Good Factory Sites—Low Building Costs—Efficient, Contented Labor—Largest Concentrated Market on Pacific Coast—Excellent Distribution by Rail and Water—Cheap, Varied Raw Materials (domestic and foreign)—Strategic Location for Export—AND LOW POWER COSTS.





Charles M. Schwab

THAT opportunity in America is omnipresent is exemplified by the career of Charles M. Schwab who rose in 15 years from a dollar-a-day job to the position of president of what was then the greatest manufacturing corporation in America, later to that of president of a new and larger combine, and finally, to that of Chairman of the Board of Directors and controlling stockholder of the huge Bethlehem Steel Corporation. Born at Loretto, Pennsylvania, in 1862, he entered the Edgar Thomson Steel Works as a stake driver at a dollar a day. He studied machinery and men, became plant superintendent, and later

headed the engineering department of the Carnegie Company. His subsequent rise was rapid. He designed and supervised erection of the great Homestead Steel Works plant, a practically continuous mill in which the raw materials go in at one end and the finished products come out at the other. He also solved the problem of how to make more and better steel at a time when this subject was of great importance. During the war, he was Director-General of the Emergency Fleet Corporation. The Iron and Steel Institute of England awarded Mr. Schwab the Bessemer gold medal on May 3, 1928.



Copyright Fairchild Aerial Surveys

### **The Woolworth Building Seeks the Sun Above the Fog**

Photographs of mountains above fogs have been made often. This one, however, of the Woolworth Tower rising majestically above a ground fog that enshrouded the surrounding buildings is extraordinary





**THE OLDEST KNOWN MASONRY SUPERSTRUCTURE IN THE WORLD**  
*Thirtieth Century B.C. The so-called "Terraced Pyramid" of Sakkara was erected by Grand Vizier Imhotep, founder of architecture in stone masonry and earliest physician known to history*

## The Oldest Known Surgical Treatise

*Nearly 5000 Years Ago the Egyptians Had  
Made Remarkable Advances in the Surgical  
Treatment of Human Ills*

By JAMES HENRY BREASTED  
*Director of the Oriental Institute, University of Chicago*

**W**HEN did man first begin to be aware of the mysteries of his own body, study its structure and investigate the nature of the extraordinary processes which it carries on? It has been said that astronomy is the oldest of sciences, and it is true that astronomy developed astonishingly early; but behind the beginnings of astronomy, mathematics and medicine, there were long stages of practical human experience which were gradually transformed into science, and it would be difficult to determine with certainty which was the earliest of the group.

**I**F we could decide the question on the basis of surviving treatises, then medicine and mathematics could claim priority, for we possess Egyptian treatises in these two fields which are considerably older than any surviving astronomical discussion; but such a decision is impossible, for all three of these sciences are much older than any surviving treatises.

\*The publication of the document in facsimile with translation, commentary, and glossary in two volumes is now being printed by the Oxford University Press and will be published by the University of Chicago Press early in 1929.

As far back as the middle of the 28th Century B.C., we find Pharaoh Neferirkere going out into the royal cemetery of Memphis one day to inspect a new building in course of construction there under the superintendence of the Pharaoh's favorite, the chief royal architect, Weshptah. The king and his court were all admiring the work, and the Pharaoh was turning with words of praise to his faithful minister, when he suddenly noticed that Weshptah was unable to hear the

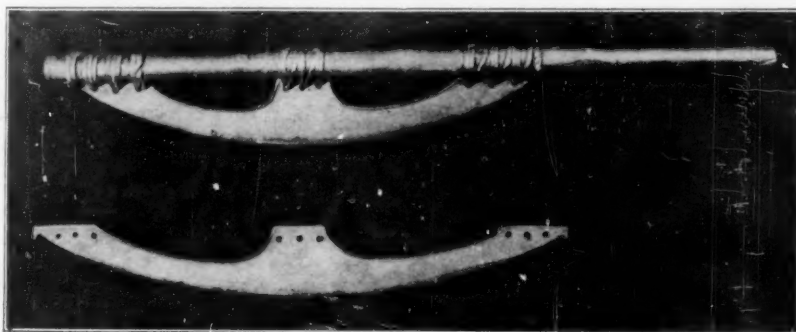
words of royal favor. The king's exclamation alarmed the courtiers.

The stricken minister was quickly carried to the palace and the priests and the chief physicians were hurriedly summoned. The ancient inscription in the Memphite cemetery, which tells us of the incident, then states, "His Majesty had brought for him a case of writings . . . and they told His Majesty that he was unconscious." The king, smitten with sorrow, retired to his chamber in prayer and ordered sumptuous arrangements for the great man's interment in a splendid tomb, which still contains an inscribed record of the circumstances of his death.

**T**HE "case of writings," which the king caused to be brought, was a case of some kind for carrying medical treatises, and Weshptah's tomb inscription therefore contains the earliest known reference to medical literature. Unhappily, none of the actual rolls from that royal "case of writings" has survived to our day. Nevertheless there is plenty of evidence of the advanced knowledge of medicine and surgery in the first great age of Egyptian civilization, which we call the Pyramid Age (about 3000 to 2500 B.C.).

One of the most interesting pieces of such evidence is a human mandible of the Fourth Dynasty (2900 to 2750 B.C.), which still contains unmistakable indications of a successful surgical operation. The patient was suffering from an abscess under the first molar, and by boring a hole through the bone below the molar, the surgeon successfully drained the abscess. This evidence corresponds with the fact that in the Pyramid Age we find a "Chief Palace Physician," who was likewise "Palace Dentist."

The court of the Pharaoh offered opportunity for medical specialization even at this remote period. A tombstone recently found in the vast Gizeh cemetery belonged to a certain Iry, who was not only chief of the palace medical corps, but also served the Pharaoh as "Palace Eye-Physician" and furthermore as "Palace Stomach-Bowel-Physician," in which capacity



**BRONZE BATTLE-AXES OF EGYPT, ABOUT 2000 B.C.**

*Wounds, undoubtedly made by exactly this kind of weapon, are shown in two of the other illustrations. Weapons are from the collections of the Oriental Institute at the University of Chicago*

he bore the titles, "One understanding the internal fluids," and "Guardian of the Anus," showing that he was particularly versed in internal medicine and that he specialized in diseases of the digestive organs.

As far back as a period beginning about 3000 B.C., therefore, the extraordinary civilization of the Nile Valley already possessed the practice of surgery and had likewise produced specializing physicians.

The earliest physician whose name has come down to us was the illustrious Imhotep, who lived not long after 3000, that is, in the 30th Century, B.C. He served the Pharaoh Zoser, whose Step Pyramid at Sakkara in the desert behind ancient Memphis, is familiar to all tourists in Egypt. Imhotep was at the same time a remarkable architect, the first great builder in stone. He was the royal architect who erected the vast Step Pyramid, the earliest surviving superstructure of stone masonry.

**T**HE gradual excavation, winter by winter, of this great structure and its adjoining buildings, is now steadily revealing to us the surprising genius of this earliest great architect, the father of architecture in stone. It is the more extraordinary that he was likewise the father of medicine, for he was an illustrious physician, whose name survived in the later ages to become the Asclepius of the Greeks, the Aesculapius of the Romans. No writings of this first architect and earliest known physician have descended to us; and as we have already observed, not a single medical roll from that royal "case of writings" has survived to our day.

It is the especial province of the Oriental Institute to study all ancient documents which disclose the rise and progress of early civilization, and not least the origins and advance of science. It was therefore very welcome news, when we first learned of the existence of an ancient copy of a surgical treatise which might easily have been among the rolls in the Pharaoh's lost "case of writings" in the Pyramid Age; for the original author's autograph manuscript was in all likelihood already in existence in the days when Weshptah dropped unconscious at his royal master's feet in the cemetery of Memphis in the 28th Century before Christ.

That original autograph manuscript left by the author himself undoubtedly perished ages ago, but copies of it were still in existence a thousand years after the author's death. All of these long ago disappeared, with the exception of one, which was made in the 17th Century B.C. This one, in so far as we know, the only surviving copy, is in the collections of the New York Historical Society. It is the oldest known surgical treatise, and at

mainder of the roll, still rolled up, in his left hand, he began copying at the right end of his long clean strip of papyrus paper. In columns over 11 inches high and varying from 7 to 10½ inches in width, his copy marched on, column after column from the right end toward the left end of his new roll.

The older roll set up before him, from which he was copying, may already have been centuries old. The venerable surgical treatise which it bore, however, was then already something like a thousand years old, and of course contained old words and phrases which were no longer wholly intelligible. A long time before our scribe was born, probably generations if not centuries earlier, some one had written out a series of explanations and discussions of these obscure words and phrases, and had scribbled them on the margin of the old surgical treatise. Eventually some scribe, earlier than ours, had copied these marginal explanations directly into the text of the treatise itself, at the close of each case discussed, so that each case was followed by a little dictionary of its difficult terms. This little dictionary had already been incorporated into the body of the treatise when our scribe sat down to his task, and he of course included it in his copy.

**H**E had copied at least 18 columns (we do not know how many columns there were in the lost introduction), containing some 400 lines, and had reached the bottom of a column, when, pausing in the middle of a line, in the middle of a sentence, in the middle of a word, he lifted his pen and ceased writing. After a

pause of which we cannot divine the cause, but during which his well-filled reed pen nearly dried, he again applied it to the papyrus. He made two more very faint strokes with the almost exhausted pen, which he thereupon dipped deep into his ink pot. After heavily retracing the two pale strokes, but so carelessly that the original faint lines are still visible, he laid down his pen and pushed aside forever the great surgical treatise he had been copying, leaving 15½ inches bare and unwritten at the left end of his new roll.

In my first study of the document, as I pushed on through the difficult discussion from column to column, it was as if I was peering through a newly revealed



THE ANCIENT SURGICAL TREATISE

The original column is about 11 inches high. The ink was made by mixing pure carbon (lamp black) with an aqueous solution of gum

the same time the earliest surviving scientific discussion.

In physical form this extraordinary document is a strip of papyrus a little over 15¼ feet long, and about 13 inches wide. At least a trifle over a foot and possibly much more, has been lost at the beginning of the strip, so that it was originally not less than 16 feet, 4 inches in length. When not in use the papyrus was rolled up and then looked not unlike a roll of narrow wall paper.

The scribe of the 17th Century B.C., taking up the clean unwritten roll, unrolled some 16 or 18 inches at the beginning (right end), and spread it out upon his knees as he squatted cross-legged. Then, while holding the re-



HEAD OF THE PHARAOH SEKENENRE

Five wounds are indicated by arrows. That in the forehead was made by a bronze battle-axe like the one shown on page 489. The pharaoh was slain in battle or was assassinated about 1600 B.C.

window, through which no man had ever looked before, and I was looking out upon the once impenetrable gloom enveloping man's earliest endeavors to understand the world he lived in. It was as if an unseen hand had been slowly raising the curtain that covered this window, and then when I reached the blank space at the end of the roll, which told me so inexorably that the scribe had stopped his copy at that point, it was as if the hand that had been lifting the curtain had suddenly refused to lift it further.

THAT provincial scribe sitting over his roll 3500 years ago, had little dreamed when he dropped his pen so carelessly and left the ancient surgical treatise incompletely copied, how hungrily future ages would ponder his unfinished transcription, the only surviving copy of the ancient surgical treatise. As already stated above, he had reproduced at least 18 columns of the earlier roll—something over 400 lines.

Beginning at the top of the head and proceeding systematically downward, the treatise had presented case after case through successive, carefully arranged discussions, forming a series of 48 cases. The scribe had been none too careful in his copying and he had made many errors. In two places he inserted on the margin unintentional omissions and indicated their proper position in the text by a cross, the earliest known asterisk in the history of books. He had industriously shifted from his black ink to his red and had liberally distributed his rubrics marking the heads of his paragraphs. He was much more interested in these matters than in the content of the extraordinary document he was

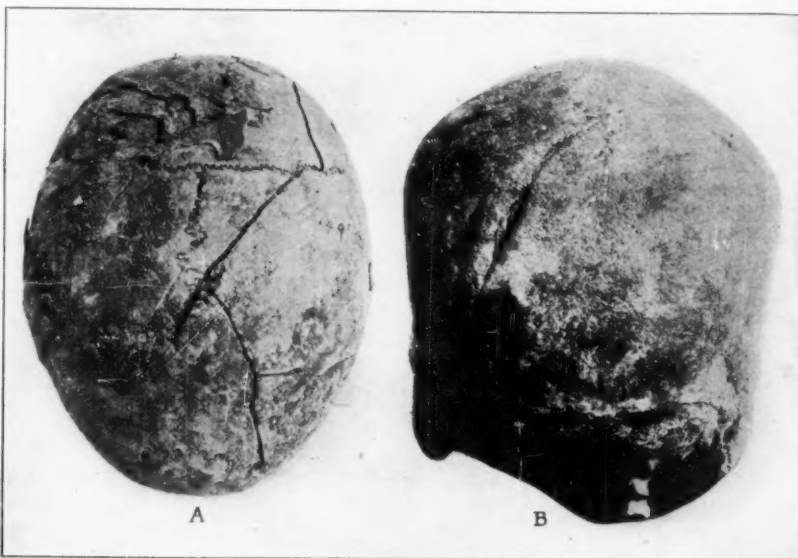
copying. He found his work somewhat trying, for it contained unfamiliar terms and unaccustomed signs like the human mandible, which caused him difficulty and sometimes resulted in awkward, uncertain characters. His copying had carried him from the human head downward through the neck to the thorax, and he had begun the first case on the spinal column, when he stopped. One can imagine him yawning, rising indifferently and going home to his dinner, quite unconcerned, and altogether unaware that he was leaving the future civilized world entirely without any knowledge of his great ancestor's discussion of the surgery of the internal organs, which

in all likelihood followed immediately on that of the spine.

Our regrets are not a little aggravated when we consider the fact that our scribe returned to his task and took out again his unfinished copy; but he turned it face downward and on the unoccupied back he began copying the customary random magical recipes current among the physicians of his time, drawn from the traditional folk medicine inherited from the superstitions of a remote past. A later hand added some recipes for a youthful complexion, including at the end especially one for "Transforming an Old Man into a Youth." These products of popular medicine have nothing to do with our surgical treatise, and they are unmistakably separated from it both by the blank space at the end of the roll, and by the fact that they are casually scribbled on the back of the roll as we ourselves jot down notes on the fly-leaf of a book. We need therefore pay no further attention to them.

THE surgical treatise itself probably served as a reference book consulted daily by the practicing physician, while at the same time it partook of the nature both of the medical lecturer's outline and the student's notebook; for the ancient medical student will have roughly reproduced the form and content of his instructor's lecture notes and may afterward have continued to employ his note-book as a reference handbook.

Some physician of ancient Thebes, in the days when the Hebrews were captives in Egypt, must have had the roll in his medical library at the close of the 17th Century B.C. When he died, there is every probability that



Photographs by Dr. G. Elliot Smith and Dr. F. Wood-Jones

## TWO ANCIENT EGYPTIAN SKULLS, DISCLOSING WOUNDS

The skull at A was cut by a battle-axe. Obviously the man was killed, for no traces of healing are visible, but the skull wound at B was treated by the surgeon, the wound healed, and the man survived



his friends placed the roll in his tomb somewhere in the great Theban cemetery in the cliffs opposite modern Luxor. It had been lying there some 400 years when the Trojan Wars were fought and the Hebrews were entering Palestine; it was over 1200 years old in the Age of Pericles, and the entire history of Europe and America has been enacted since our scribe made his copy.

Then, when it was some 3500 years old, it was presumably found by Luxor natives, probably in a Theban tomb, although there is no specific evidence indicating exactly where these natives had found it. Shortly afterward an American named Edwin Smith, who had been residing in Luxor for some years, purchased it during our American Civil War, more exactly in 1862, from a Luxor native named Mustapha Aga. Mr. Smith died in 1906 and his heirs thereupon presented the unique document to the New York Historical Society, to whose Executive Committee the present writer owes the opportunity of describing it.

**T**HE Papyrus nowhere hints at the name or station of the author of the surgical treatise. We are free to wonder whether the great unknown surgeon who produced this earliest-known investigation of human anatomy, physiology, and pathology could have been identical with our oldest-known physician, the venerable Imhotep, the father of both medicine and architecture already mentioned above, who lived in the 30th Century B.C. It is evident from his treatise that our ancient surgeon, whoever he may have been, was a man of observant and discerning mind, with a wide outlook upon the life of his time. The terms which he uses convey the impression of a man actually involved in the process of building up a terminology in a field of observation not yet possessing a fund of current terms.

He seems to be doing for the first time in any field of science what has since happened in one area of scientific observation after another.

**H**E draws his items of comparison and his descriptive terms from nature, from the mechanical arts, from architecture, and from many sides of daily experience. He has observed the crucibles of the copper foundry and he compares the convolutions of the human brain to the corrugations on metallic slag. In describing the articulation of the human mandible with the skull, he likens the fork at the head of the ramus where the mandible hangs pivoted, to the claw of a two-toed bird clasp the temporal bone—a very apt comparison. He applies the name of a certain water worm to fibrous strings of coagulated blood, and the ancient commentator carefully explains that the actual worm itself is not meant; the region of the frontal sinus is “the secret chamber,” as of a sanctuary; the bridge of the nose is for him “the column of the nose”; a puncture of the cranium is compared with a hole broken through the side of a pottery jar.

Socially considered, the treatise is the outgrowth of the earliest great age of civilization, the age that first saw a civilized society of some millions of souls organized into a homogeneous



Courtesy of Dr. G. Elliot Smith

#### AN EMBALMING WOUND

Stitched by the 11th Century B.C. embalmer. Much earlier surgical stitching is described in the Edwin Smith Surgical Papyrus

nation. It was only in such a situation that oriental medicine could develop and in any measure approximate the character of a science. We find this fact illustrated when we take up the study of the cemeteries where the Egyptian communities buried their dead several thousand years ago.

**A**SINGLE campaign of excavation which exhumed between 5000 and 6000 bodies, disclosed one person with a fractured bone among every 32 people, that is, over three such injuries among every hundred people. A broken neck is stated by our treatise to have been caused by a fall on the head—evidently from some elevation. Among the mechanics and workmen employed on the vast buildings of Egypt, such as the Great Pyramid of Gizeh, there must have been many such accidents. We can easily understand why there are 33 cases of injured bones among the cases discussed in our treatise. Many, perhaps most of these injuries, were received while the injured man was following the peaceful routine of civil life.

No one can read the treatise, however, without concluding that some of the wounds in the skull, for example the “perforations” found in the skull, the temporal bone, the zygoma and the sternum—not to mention the gashes in the soft tissue of the nose, lip, chin, outer ear, neck and shoulder—were spear and sword wounds received in battle. Some of



#### SKULL OF HARSIESE, HIGH PRIEST OF AMON

Ninth Century B.C. He was struck on the forehead. The bone shows signs of absorption; death was not instantaneous. The Edwin Smith Papyrus discusses perforations of the skull like this. Discovered by the Oriental Institute Expedition of the University of Chicago last winter



the experience and knowledge of the human body which the ancient author discloses, was therefore doubtless gained on the battlefield while following the armies of Egypt. In harmony with this observation, it should be noted that the patient is always a man.

The illustrations accompanying this article and showing wounds received

process of eviscerating and embalming.

Our ancient surgeon was therefore already acquainted with the brain, and the word "brain" appears in this treatise for the first time in human speech, in so far as early records are preserved to us. He had observed that the brain is in intimate connection with the control of the limbs, and he

followed by a diagnosis based on the examination and continuing with a treatment, if any is possible. The treatment is only slightly medicinal, the most notable office of the surgeon being his mechanical manipulation. It is interesting to find him practicing surgical stitching or "suture," the earliest known application of this mechanical aid to healing, and when he found stitching impracticable, he employed adhesive tape or plaster. His directions for setting dislocated or fractured bones show a good understanding of the proper physical manipulation, and his instructions for reducing a dislocated human mandible are closely reproduced in an illustrated edition of the essay on the joints written by Hippocrates over two thousand years later than our Egyptian surgical treatise.

It is clear that the ancient Egyptian surgeon was daily called upon to deal with human ills which were the obvious result of observable physical causes, and having therefore no connection with the malignant demons of disease popularly regarded as the source of all ailments of the human body. For our treatise shows us the surgeon examining case after case of organs and tissues injured by intelligible physical agencies forming a realm of familiar forces, quite uninvaded by magical powers.

IN this realm the ancient surgeon was able to gather a considerable body of fact regarding human anatomy, physiology, and pathology—the earliest known recorded group of rational observations in natural science. Indeed these two men, the unknown surgeon who was the original author of the treatise, and his later, equally unknown successor who wrote the little dictionary of technical terms, both of them living in the first half of the third thousand years B.C., were the earliest known natural scientists.

It is quite evident that the work and writings of such Egyptian medical men could not have remained unknown to the great Greek physicians, who carried on their investigations in Alexandria after 300 B.C., side by side with the Egyptian medical schools, one of which we know was refounded a few generations earlier by Darius the Great at Tanis, within a stone's throw of Alexandria. Our unknown Egyptian surgeon, and his colleagues reaching back to Imhotep of 5000 years ago, were therefore the scientific ancestors of modern medical scientists who have probably been accustomed to regard their scientific ancestry as reaching back no farther than the Greeks. The modern physician, however, is entitled to consider himself as a descendant of a venerable line which may be traced back to the 30th Century B.C., and this can not be said of any other modern scientist.



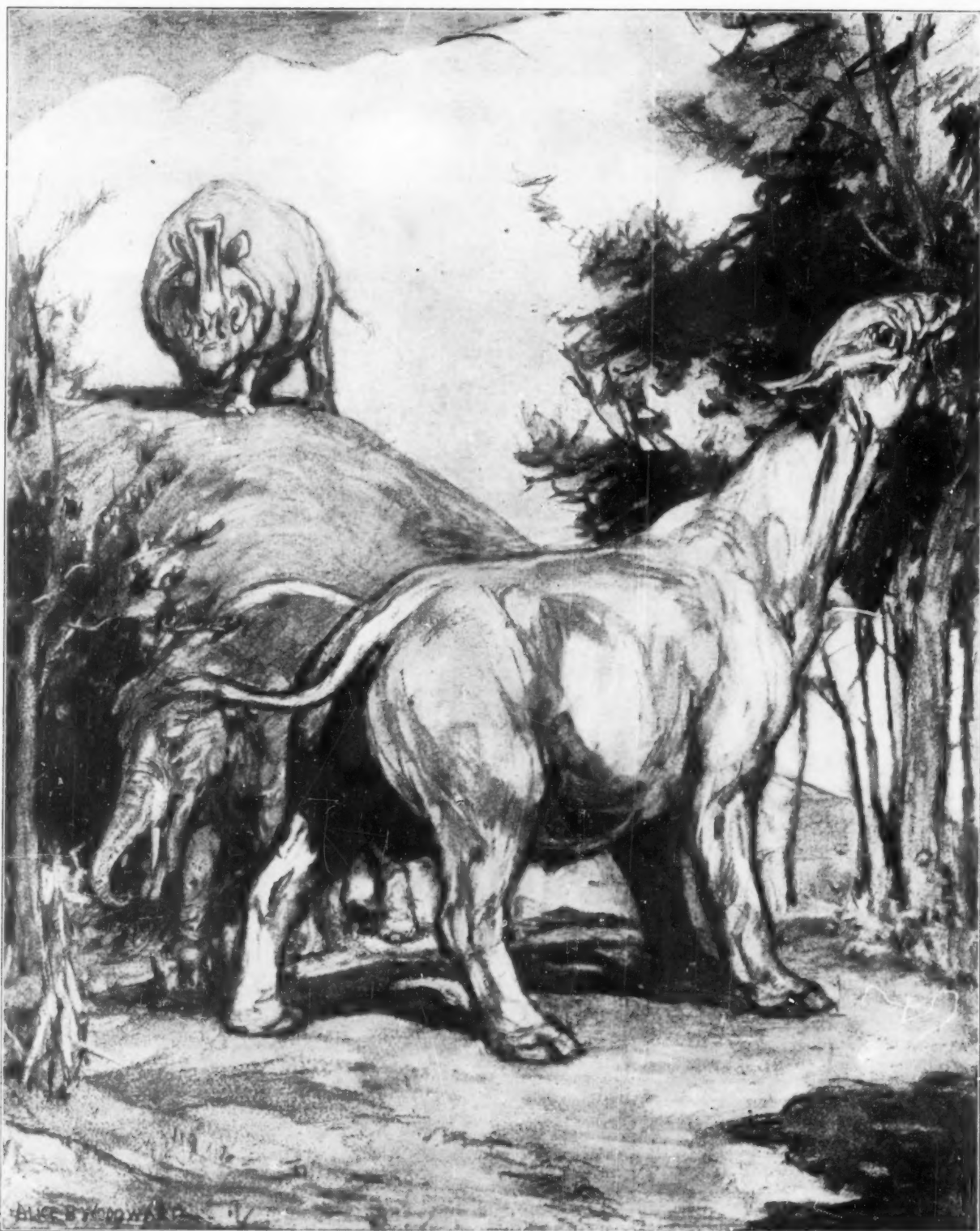
#### REDUCTION OF A DISLOCATED JAW

*This picture is Greek—First Century B.C. The surgeon's position is exactly the same as prescribed in the Edwin Smith Papyrus and thus shows that the older Egyptian medical science influenced early Greek medicine and surgery*

in battle, would also confirm this conclusion. Extraordinary evidence of the same kind has recently been published by the Metropolitan Museum of New York in the form of a series of wounds found on the bodies of a group of 60 soldiers who fell in battle in the 21st or 22nd Century B.C., and were buried in the same tomb at Thebes. There is also other knowledge of organs and tissues which would indicate that our ancient surgeon practiced dissection of the human body while carrying on these earliest known investigations in anatomy and physiology. In this way the surgeon gained knowledge which could not have been acquired in the mere

had already noticed the localization of function in the brain. He charges his readers to note the side of the skull on which an injury is found, and to correlate it with the side on which paralysis of the lower limbs occur. He was aware of a cardiac system, with the heart as its center, and he knew that the action of the heart extends to the remotest extremities, but he does not indicate a knowledge of the circulation of the blood, although he was without doubt close to that observation.

He arranges his cases very systematically. Following the title which is always at the head of the case, he introduces his discussion by the record of the examination of the patient



Courtesy Illustrated London News

### A Prehistoric Scene in Mongolia

THE 1928 expedition of the Central Asiatic Expedition of the American Museum of Natural History, led by Roy Chapman Andrews, has completed its work, and the reports of the findings are extensive and interesting. The above illustration, drawn by Miss Alice Woodward, shows the probable appearance of three of the prehistoric beasts, bones of which were discovered by the expedition. In the

foreground is what is conceded to be the largest land mammal known—a giant Baluchitherium, standing from 13 to 14 feet high at the shoulder. This animal fed on the leaves and twigs of trees. On the top of the knoll is a new species of Titanotherium, with an extraordinary, long, spatulate-shaped nose. In the left background is a shovel-toothed mastodon. Its peculiar teeth are nearly a foot long.

# OUR POINT OF VIEW

## Secrecy and Science

**M**OTH-BALLS, known to chemists as naphthalene, belong in fur coats; not in an automobile gas tank. Neither they nor any of the numerous *secret* dopes sold under the claim that they have anti-knock or power-increasing characteristics, have any good effect on the gasoline, according to findings of the Bureau of Mines.

The fallacious theory that moth-balls, dropped into the gas tank, will give an anti-knock mixture, is widely prevalent. With a carburetor adjusted for too rich a mixture, naphthalene increases the viscosity of the fuel so that the volume fed is cut down, thus actually giving more miles per gallon of gasoline, *but* the same result can be obtained by proper adjustment of the needle valve.

There are many secret dopes on the market masquerading under fancy trade names and perhaps perfumed and colored. Some of them are simply powdered moth-balls while others are composed of harmless and ineffective coal-tar products. Most of them are frauds.

The scientific formulas of responsible manufacturers are not secret. Some day, perhaps, an anti-knock substance more efficient than the present ethyl fluid may be developed. If it is, the chances are some-odd millions to one that it will be the product of many years of constant research and labor and the expenditure of large sums of money rather than the chance discovery by an ordinary person. And, although it won't be an ordinary chemical, its formula will certainly not be kept secret.

## The Inter-American Highway

**I**T will not be a great many years before a single broad highway will stretch with never a break from the Dominion of Canada to the Republic of Argentina. Here and there on the southern half of this main road, branch roads will shoot out to the east and west, so that every country in North America and South America will be in contact with this one great artery.

Afoot and ahorse and awheel, men and women will travel from one land to another, exchanging their merchandise and their ideas. Nations now separated not alone by natural barriers but by barriers of misunderstanding will be brought closer together. Whatever the highway will have cost will be only a fraction of its value to mankind.

It is no idle dream. The Seventieth

Congress passed a resolution authorizing Government assistance in the construction of such a highway, and the House Committee on Foreign Affairs has published its report on the project. And one of the strongest

## John Bernard Walker

**A**N editor's success depends upon the extent to which he commands the confidence of his readers and the amount of influence his writings exert upon the thoughts of others. He is to be eulogized when throughout his career he has gone to the bottom of subjects and has then presented them in a clear and thought-provoking manner, without fear or favor.

John Bernard Walker, who died on October 17, 1928, after an illness of three months, was just such an editor. Evading no issues, he fought his verbal battles with a keen zest for the truth regardless of consequences. Born at Bournemouth, England, in 1858, he came to this country in the late eighties, became a member of the editorial staff of *SCIENTIFIC AMERICAN* in the early nineties, was one-time editor and, at the time of his death, editor emeritus. He had retired on January 1, 1928, due to ill health and was traveling and continuing to send in contributions when stricken with a fatal illness.

Mr. Walker was an authority on army and navy affairs, on yachting and modern engineering. He was a careful worker and was always sure of his facts. The editorial page for years was made up largely of contributions from his indefatigable pen. He was a naturalized citizen and enjoyed not only the friendship of a host of army and navy men but also the confidence of men high in governmental positions. Always a strong proponent of preparedness, he assisted greatly in promoting a general desire for preparedness prior to the World War. While the bulk of his writings appeared in *SCIENTIFIC AMERICAN* he also wrote "The Unsinkable Titanic" and "The Story of Steel."

We know that the thousands of readers who have enjoyed his writings and have been guided or influenced by Mr. Walker's written thoughts, will join with our editorial staff in this expression of sorrow for his demise.

reasons for the construction is its value to aviation. Not only will the highway serve as a marker for those who travel by air, but it will be of such width that at any point and at any time it will afford a safe landing place for planes forced down.

## Seaplanes

**A**FTER each serious aircraft accident involving a land plane and water, the cry goes up for regulation of over-water flights with planes which can land only on more or less dry ground. Why have many aviators, who know the hazards of over-water flight, undertaken just such projects with equipment designed for operation over land? The answer is simple. Land planes are comparatively light in relation to engine power, and so can carry more fuel than a similarly powered seaplane. A plane designed for water work, that will be reasonably seaworthy when forced down, has a considerable proportion of its total weight concentrated in its floats, regardless of the form they may take. As fuel is the most vital consideration in a flight of great duration, land planes are frequently selected for work other than that for which they were designed and for which they are safe.

Before seaplanes can become practical for long-distance flights with economy of operation, engines must be designed which will lift them as well as the huge amount of gasoline which must be carried. It is all a matter of engineering. When more powerful engines are built, seaplanes will come into their own.

## Doubtful Altruism

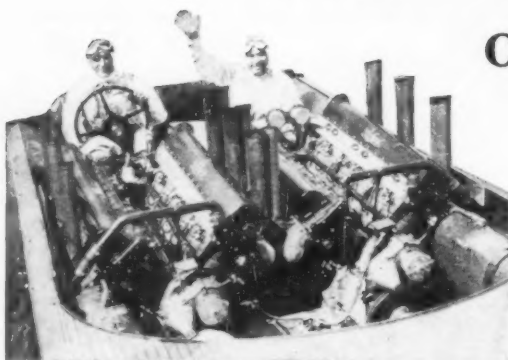
**W**HEN Dr. R. W. Browne went to Fort Bayard, New Mexico, not long ago to take charge of the Veterans' Hospital, he found life in an automobile was just one puncture after another. A large number of temporary buildings had been torn down and the lumber salvaged; the roads over which the lumber was hauled for storage was full of nails, tacks, and other sharp pieces of metal.

Being a practical man, he called Chief Engineer Martin. They took an old Ford car minus wheels and top and set it on a truck. This supplied power to run an electric generator that happened to be idle. Then they made a magnet out of a 12-inch I-beam four feet long, mounted on an old Ford axle. With this device they went out on the roads and in no great time picked up 4690 pounds of nails and other metal. Punctures thereafter were reduced by 75 percent.

But you can't please everybody. The garage owners wish the doctor had stayed in the east where he belonged. The large income they enjoyed from tire repairs on the road from Fort Bayard to Silver City has been cut off almost entirely.



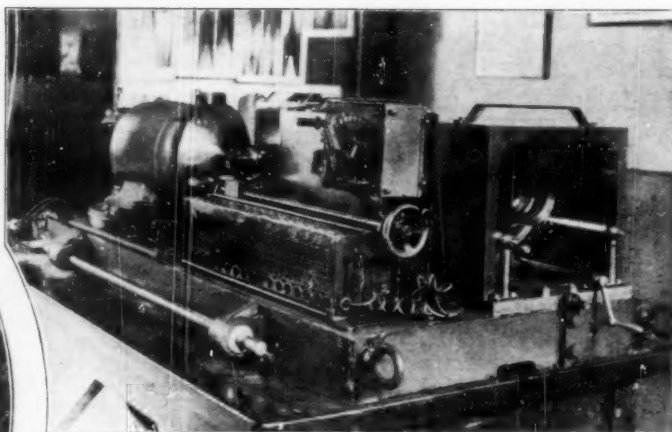
# From the Scrap-book of Science



P and A

## A NEW SPEEDBOAT RECORD

George Wood and his mechanic in the stern of *Miss America VII* in which Wood recently made a new world's record of over 92 miles an hour on the Detroit River. Above at right: the speeding boat

Illustrated  
London News

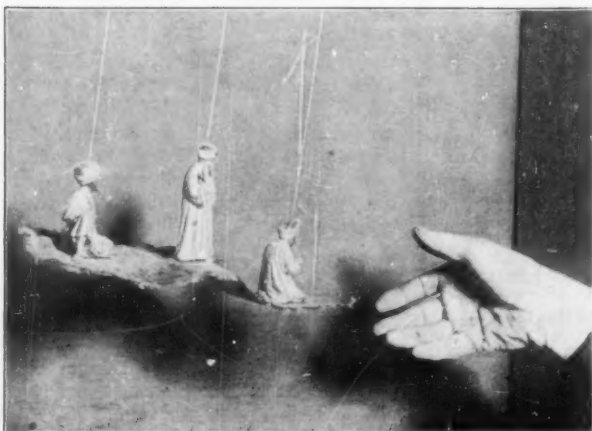
P and A

## ◀ FOR CAPTAIN COOK

The strip of ground on which stands this monument, erected in Hawaii in 1874 to the memory of Captain Cook, discoverer of the Sandwich Islands (now Hawaii) who was killed on this spot, is British territory. Since a great many visitors land here, Australia plans to build a new stone jetty in front of the monument

## ▲ ONE-TON CAMERA

Called Fraser's High-Speed Drum Camera and invented for the purpose of photographing swiftly-moving flames and explosions, this one-ton camera was designed by Professors R. P. Frazer and W. A. Bone of the Imperial College of Science, England. Exposure is one ten-thousandth of a second



Hubert

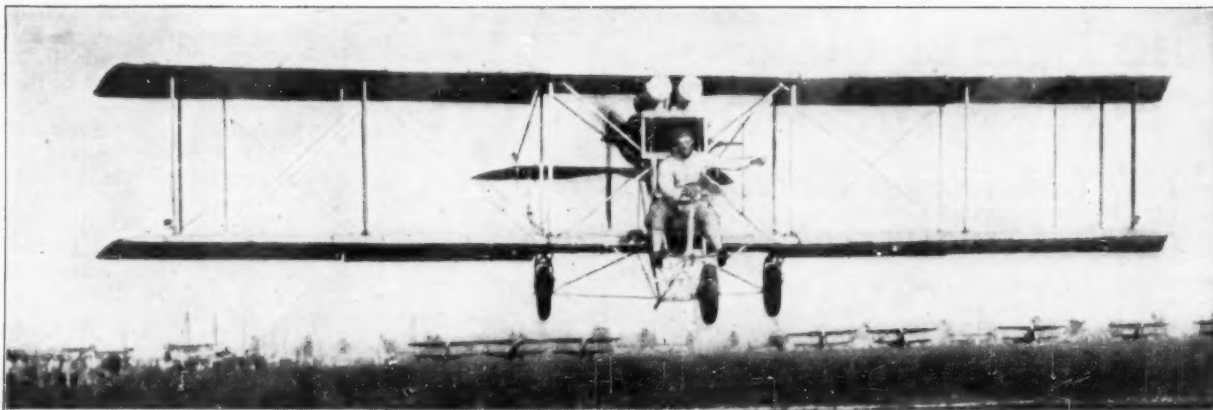


## HERE'S THE "LOW-DOWN" ON THE "MOVIES"

Those of you who saw "The Thief of Bagdad" will remember the magic carpet scene shown above. All that was necessary in order to shoot this scene was the construction of this miniature, suspended and manipulated by tiny

wires, invisible in the studio light, to obtain that softly undulating effect. Above is shown the tiny "ocean liner," *Fanny*, also used to create an illusion. In a tank no larger than a bath-tub, it was tossed by electrical mechanism





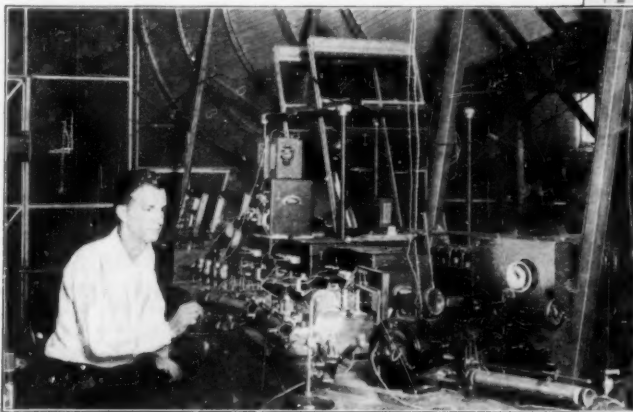
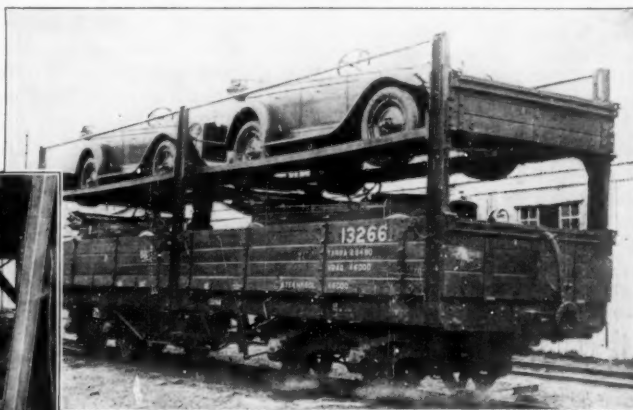
#### OUT-STUNTING MODERN PLANES WITH AN OLD ONE

A tremendous crowd of 80,000 people at Mines Field, Los Angeles, California, got a real thrill when Al Wilson, an ace among stunt fliers, took an old airplane of the vintage of 1910 aloft and performed stunts that would be difficult

even with modern aircraft. The plane was a Wright pusher type biplane on which there is no fuselage, the pilot sitting in an exposed position in front, and the rudder and elevator extending behind on a skeleton frame

#### DOUBLE-DECK RAILWAY TRUCK

Designed, patented, and built in South Africa, this double-decked railway truck is used to transport automobiles fully assembled and ready for driving. The photograph shows how efficiently space is utilized, each truck having twice the capacity of old types of car-carrying trucks



Henry Miller

#### ERROR CHECKER

A. M. Kuethe of the Bureau of Standards in Washington, operating the equipment designed to find errors in wind tunnel readings. The elaborate audio amplifier is used to record variations in heated wires interposed in the air stream of the tunnel. The equipment is complicated. In the upper part of the photograph the wind tunnel may be seen



George Stone from Lwing Galloway

#### THE EXPLORERS HAVE AN AUDIENCE

Marine iguanas, supposed to be throw-backs to reptiles of prehistoric times and sometimes six feet long, come out to watch members of the Galapagos Expedition for the Visual Education Service of Los Angeles, California, as they work on their collection on Albemarle Island of the Galapagos Group during their explorations



#### SEXTANT CAMERA

Invented by Commander M. R. Pierce, U. S. N., this camera is to be used by Commander Byrd in the Antarctic. It photographs a reading of the sun in relation to the horizon

# The Secret of the Bladderwort

*This Carnivorous Aquatic Plant Is An Efficient Trapper of Small Animals. The Mechanism of Its Trap, A Unique Device Which Operates by Suction, Has Recently Been Discovered*

By ALEXANDER F. SKUTCH, Ph.D.

Johns Hopkins University

ONE of the fundamental differences between plants and animals is in the manner in which they obtain their nourishment. Plants fill all of their material requirements with relatively simple substances which they draw quietly, imperceptibly from the soil and air, and for their energy they imprison a portion of the force of the sun's rays. The whole process of the nutrition of plants is so silent, so unobtrusive, involves particles so far removed from the limits of even microscopic vision, that mankind had eaten plants, cultivated plants and bred plants for untold centuries before he obtained the slightest inkling of what plants actually do require for their nourishment.

Animals, on the other hand, must seek gross particles of complex substances such as grass or fruit or flesh, and whether the beast be carnivorous or vegetarian, we can, in the final analysis, trace the food to its source in plants.

A MORE thorough study of the physiology of plants reveals to us that it is only the green plants which are self-sustaining in the strictest sense. Already, when we have picked our first mushroom, if we read its story rightly, we learn that all plants are not the splendidly independent organisms which others seem to be, but some have degenerated to the point where they must derive sustenance from the decaying bodies of others, or even of animals.

These scavengers of the vegetable world we call saprophytes. Others, the parasites of the plant world, prey upon the living tissues of other plants, or in some cases upon living animals. Yet both saprophytes and parasites appropriate their nourishment in particles beyond the limits of microscopic vision, and do not, like animals, gulp down tangible portions of food.

There is a small but immensely interesting group of plants which

approaches still more closely the habits of animals in matters of diet, in that they capture and in some cases actually engulf living creatures. These have been called the insectivorous plants, but such an appellation is not strictly correct, for many of the small animals which fall a prey to these plants belong in other classes; and so it is more proper to term our plants carnivorous.

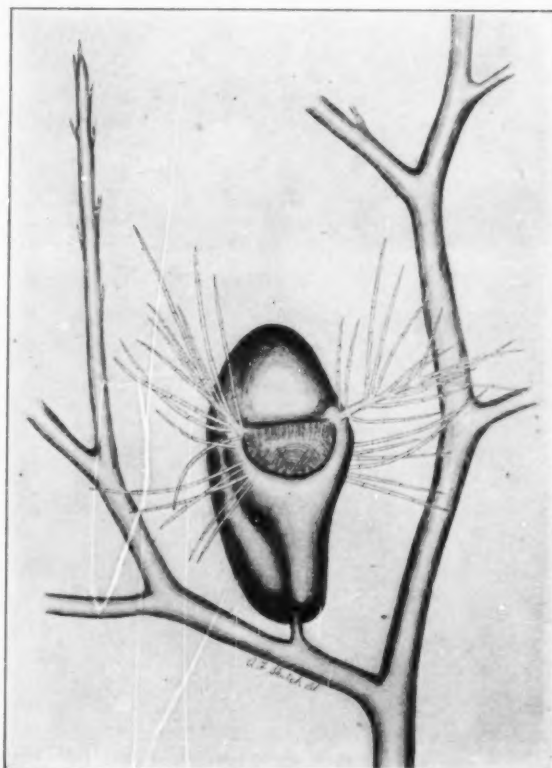
It is of considerable significance that all of the carnivorous plants belong to the group of flowering plants, and practically all of them are provided with the green pigment chlorophyll, so that they are able to build up carbohydrates and to secure their own energy from the rays of the sun. This circumstance sets them off sharply from the great host of wholly dependent saprophytic and parasitic fungi, and from most of the parasitic flowering plants. Their carnivorous diet merely supplements the nourishment they are able to synthesize from the substances they draw from the soil, or water, and the air. It seems that they entrap small animals primarily to meet a deficiency of nitrates and other salts which is felt in their native soil or water, by utilizing animal proteins, which are a rich source of the necessary elements.

What a most amazing array of ingenious pitfalls and snares are presented to our observation and thought, by these carnivorous plants! The leaves of

the marsh-dwelling sundew are covered by a number of tentacles which radiate from the upper surface like pins from a pincushion, and are expanded at the ends into spherical glands—the pin heads. The glands are enveloped in a sticky fluid which they secrete, so that they glisten in the sunlight like so many morning dew-drops, whence the name. If an unsuspecting insect, either by chance or attracted by the shining dew-drops, alights upon the leaf, it is held fast by the sticky secretion.

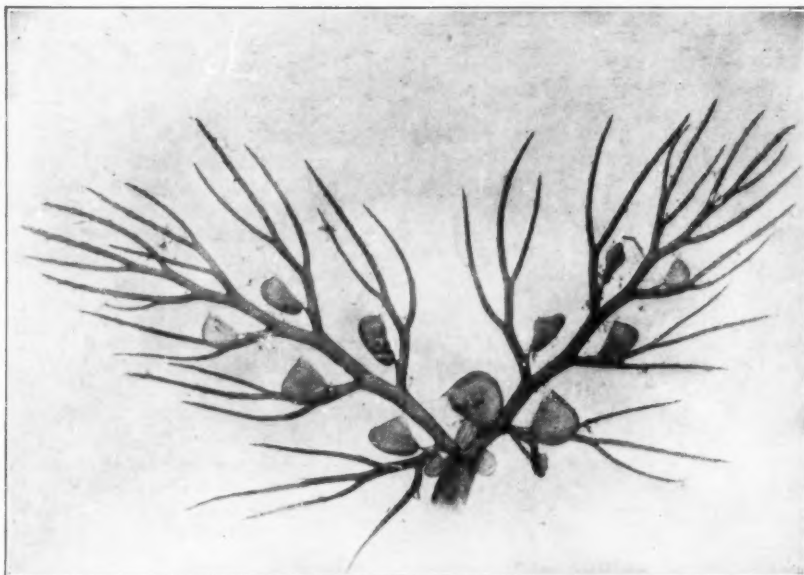
ITS struggles to regain freedom result only in stimulating more of the tentacles to bend their sticky heads over it and hold it in a firmer embrace, so it is the old story of Br'er Rabbit and the Tar Baby over again. This octopus of plants long anticipated the tactics of the fowler with his bird lime. The insect is digested by a secretion which the versatile glands pour over it, and by these its nitrogenous compounds are absorbed into the leaf.

Then there is the Venus's fly-trap, a small, white blossomed herb which is confined to a restricted portion of the Carolinas. The leaves are hinged in the middle, and each half bears several peculiar bristles upon its upper surface. When an insect, crawling over the leaf, happens to bend one of the bristles, the two halves spring



THE TRAP SET FOR A CAPTURE

Here the bladder is enlarged about 15 times. The valve with its four bristles and its many glandular hairs shows plainly



A SINGLE LEAF OF THE GREATER BLADDERWORT

*Enlarged about three times, with the attached bladders, viewed from behind. Over 100 bladders have been counted upon a single leaf of the plant; usually, however, there are only about a dozen*

rapidly together, the long comb-like teeth which cover the margins interlock, and the prey is firmly entrapped. To compare our plant again with man-made devices, one thinks first of the cruel steel trap.

The pitfall has been developed to a high degree of perfection by several genera of carnivorous plants. The most familiar is our pitcher or side-saddle plant, a denizen of cold sphagnum bogs of eastern North America. The trumpet- or pitcher-shaped leaves of these plants all operate on the same principle: the animal crawling over the mouth of the trumpet ventures onto the slippery inner wall, where it loses its footing and glides down to the bottom. Its escape from the bottom of the pitcher is made difficult by bristles all pointing downward. Once inside, the animal decays, in our native pitcher-plant, through the agency of bacteria, and its nutritious residues are absorbed into the leaf.

**T**HE bladderworts, with their minute suction traps, are in many respects the most remarkable of all animal-trapping plants. Our most common native species, the greater bladderwort, grows in ponds and sluggish streams throughout most of the eastern and central portions of our country, while an almost identical form is found in Europe, the temperate regions of Asia, and our own northwest. During the mild seasons, the long, slender, green stems, clothed with delicate, many-parted leaves, float just beneath the surface of the quiet water. They grow continuously through the warm weather and may attain a yard or more in length.

Roots of any kind are totally lacking, and the unattached plants drift at the mercy of wind and currents.

During the height of the summer, the slender flower stalks are raised above the surface of the water, where each supports from five to a dozen conspicuous yellow flowers in the sun and air. In the autumn, after the seeds have matured, the stem ceases to elongate and develops a compact mass of leaves, resembling a bud, at its tip. The leaves and stem behind the bud die off, and finally it sinks to the bottom, where it survives the winter months among the mud and fallen leaves and decaying pond vegetation. With the return of spring, the resting bud is called into renewed growth by the rising temperatures. Becoming buoyant again, it rises to the surface and expands into a new shoot, which repeats the cycle of its precursor of the previous year.

The bladders, which are the traps of the plant, are borne upon the richly branched leaves. In warm weather these leaves become very long, and during the height of the summer over a hundred bladders have been counted upon a single

leaf; but this is a rather unusual number, and only a dozen or so are more commonly found.

The accompanying figures should convey an adequate idea of their form; their length is about one eighth of an inch. The transparency of the light green walls, which are only two cells in thickness, gives the bladders an appearance of delicacy. The long, much branched appendages, which spring from either corner of the mouth, were termed "antennae" by Darwin, from their resemblance to the antennae of a small crustacean. These and the slender bristles below them probably serve to guide the prey to the entrance.

**T**HE valve, or door which gives access to the interior, which is situated at the end opposite the stalk, is roughly semicircular in outline, and is attached by its curved upper margin. The free margin rests upon a thickened pad or sill in such a manner that the valve may be pushed inward but not outward. The surface which faces outward is strongly convex, and bears, near its free margin at the middle, four bristles, two long and two short. Stalked glands, which secrete a mucilaginous substance, are numerous on the valve and on the sill.

Turning to the inside of the bladder, we find that its walls are studded with numerous four-armed hairs arranged at regular intervals. We have not



INSECT PITFALLS

*Sarracenia Catesbaei, a pitcher plant from our southern states. The pitchers are deadly pitfalls for many insects*



mentioned nearly all of the bewildering variety of appendages of the bladder, but for our present purposes these will be sufficient.

The trap-like construction of the bladder is obvious. A small aquatic animal, pushing against the valve from the outside, may force it inward and so enter the bladder, but once within it cannot retrace its path, for to press against the valve from the inside results only in forcing it more firmly against the sill. Apparently it is all as simple as the principle of the cage rat trap, which no one but the rat finds it difficult to understand.

But why should the animal enter the bladder, since no living creature voluntarily immolates itself? The rat enters the trap for the cheese, but is there anything desirable within the tightly sealed bladder which is sensed by the animal on the outside, and stimulates it to force its entry? This is a problem which has interested botanists ever since, in 1858, the Crouan brothers, pharmacists and amateur botanists of Brest in France, communicated to the scientific world their discovery that the bladders often contain imprisoned animalcules.

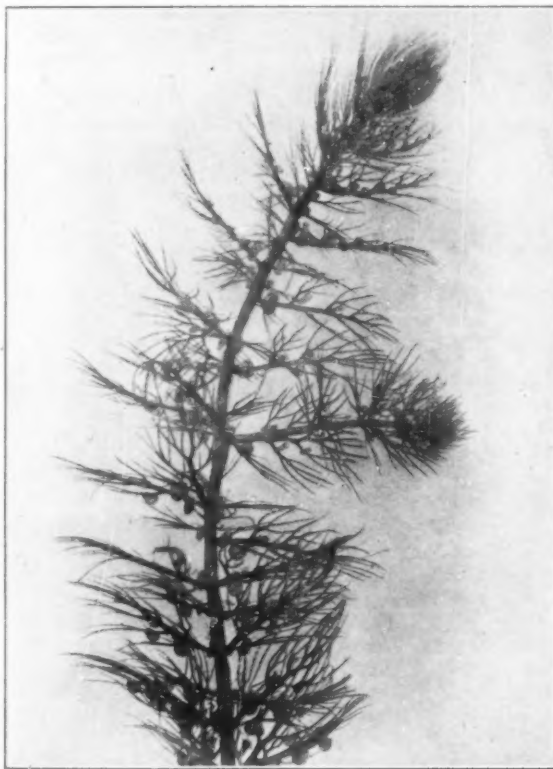
**C**HARLES DARWIN was the first and greatest biologist to consider seriously how and why the animals which are entrapped in such large numbers enter the bladders. In spite of long and painstaking observations, which he describes in detail in his great work "Insectivorous Plants," he failed to arrive at a satisfactory explanation. He suggested that the animals might be attracted to the bladder to feed on the mucilage abundantly secreted by the many glands surrounding the orifice, and might even "habitually seek to intrude themselves into every small cavity, in search of food or protection," but he ends with the unsatisfactory conclusion that "animals enter merely by forcing their way through the slit-like orifice, their heads serving as a wedge." And in the years which followed, many other able botanists endeavored to penetrate the mystery of the bladderwort, with results equally inconclusive.

Then, about 20 years ago, the Swiss entomologist Frank Brocher became dissatisfied with the generally accepted theory of Darwin. He believed that no one had followed in sufficient detail the entry of an animal into the bladder, and determined to do this for himself. He pushed about small crustacea, injured so that they

could not too readily swim away, upon the upturned surface of the valve, and followed the results with a microscope. In a few cases they suddenly disappeared, to be found later inside the bladder. Next he tried shooting small crustacea against the valve from a fine pipette, usually with no interesting result. Once, however, the animal disappeared inside the bladder, and with it went a bubble of air to which it had become attached while within the pipette. This minute bubble of air was the revealing evidence which unlocked the whole mystery! It told Brocher that the bladder

The secret of the bladderwort once having been penetrated, it was destined to be revealed thrice again before it should become general information. In the year 1916, the late Dr. C. L. Withycombe, then a boy of 18, noticed while observing the bladders with a hand lens that they expand actively on engulfing their prey. This was in England, but in India in the same year another naturalist made the discovery for himself under quite different circumstances.

While distributing for class study specimens of an Indian bladderwort with very large bladders, the botanist T. Ekambaram was attracted by crackling sounds, somewhat resembling the ticking of a watch, which he heard as he lifted each spray from the water. He was able to satisfy himself that the sound emanated from the bladders, which expanded suddenly and sucked in air as they were drawn through the surface film of the water, and he recognized that this almost explosive dilation was their method of capturing prey.



BLADDERWORT—LATE SUMMER

*The bladderworts have no roots but they have flowers and they mature seeds. The plants' whole life cycle is unusual*

expands as it captures its tiny prey.

Following this clue, he was able to observe that the bladder becomes suddenly distended when one touches with a needle the valve or one of the four bristles which it bears. The same thing would of course occur if the valve or its bristles were disturbed by the impact of a small animal. In expanding, the bladder sucks in a current of water, which carries with it the small creature which made the unfortunate collision. So the bladder is a suction trap, and draws in its prey exactly as the biologist picks up a small swimming organism by releasing the pressure on the bulb of his pipette at the proper moment, or as one fills a medicine dropper, or even his fountain pen.

**F**INALLY, in 1925, Professor R. W. Hegner, of Johns Hopkins University, who was studying the fate of minute protozoa entrapped within the bladders, incidentally made the discovery that the bladders capture their prey by suction. Thus the secret guarded so long was revealed on four separate occasions by four different workers in as many different countries, none of whom was at the time of his discovery familiar with the work of the others.

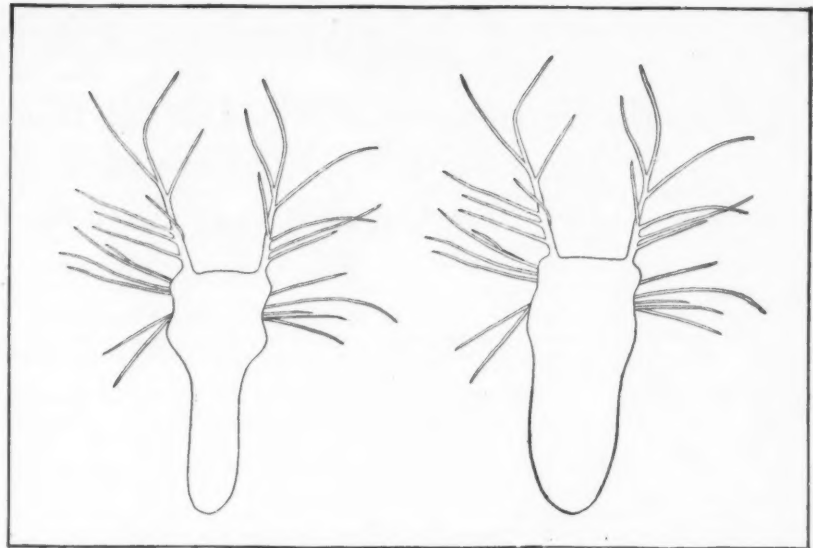
These observations told us how the victims are sucked into their green charnels, but the answer to this question only raised another: How does this rapid expansion come about? What is its mechanism? To make the complete discovery of the secret of the bladderwort a thoroughly international affair, as all good science is, it happens that we owe our explanation of how the snares work to the recent labors of two German botanists, Edmund M. Merl and A. T. Czaja. It is evident from their studies that the release of the set trap is not, like the folding together of the leaf of the Venus's fly-trap, connected with a specialized, sensitive motor organ, but is as purely a mechanical process as the springing of a mouse trap. Let us choose a bladder which has just expanded and follow its subsequent behavior.

After the entry of the first victim, the valve, in virtue of its outward



convexity, springs forward against the sill, where it forms a tight seal because of the thick, slimy covering. The four armed hairs studding the inner wall continue to absorb water from the cavity of the bladder, and this is by some unknown method conveyed outside the plant. Since the tight seal makes it impossible for more water to enter, the side walls are slowly forced together by the pressure of the atmosphere and the overlying water, just as the cheeks are forced against the teeth when one closes his lips tightly and sucks the air from his mouth. The sides of the bladder are elastic and tend to expand, which would draw in the valve and admit more water if the outward curvature of the former, intensified by the pinching of the indrawn walls, did not resist the excess pressure on the exterior.

**I**F now, 20 or 30 minutes after the snare made its previous capture, a small swimming creature impinges against the valve or its bristles, the whole unstable system is upset. The shock breaks the seal, and now the walls are able to relieve their strain by drawing in a current of water through the aperture, and the ill-omened creature which sprung the trap is carried along by this current. Let us return to our former example of the medicine dropper. We squeeze the bulb and then, putting a finger over the end of the glass tube, release the bulb. The latter remains compressed and corresponds to the set bladder; what happens when we remove the finger from the tube is precisely what occurs when a water animal breaks the seal of the bladder. The whole process occurs in the winking of an eye; one instant the animalcule is swimming against the bladder, the next it is beating against the prison walls in vain search of an



BEFORE AND AFTER SPRINGING THE TRAP

*The bladder on the left is set. That on the right has been sprung by the touch of a needle. Sprung bladders contain 75 per cent more water than set bladders. Note difference in size.*

avenue of escape from its death cell.

Once inside, the animal dies, but often not until after it has been several days a prisoner. It is slowly digested by a very weak digestive ferment, and its substance is absorbed by the four-armed hairs.

The same bladder may be sprung repeatedly, and resets itself each time in from 20 to 30 minutes, even while digesting its latest booty. Set bladders may be distinguished from sprung bladders by the empty appearance of the former and the full appearance of the latter.

If a hole is punched in the wall by a needle, or if a fine hair is inserted between the valve and the sill, so that water can enter freely, the bladder naturally can not become set again, but remains permanently distended. Cold and excessive heat and moderate amounts of poison may prevent the

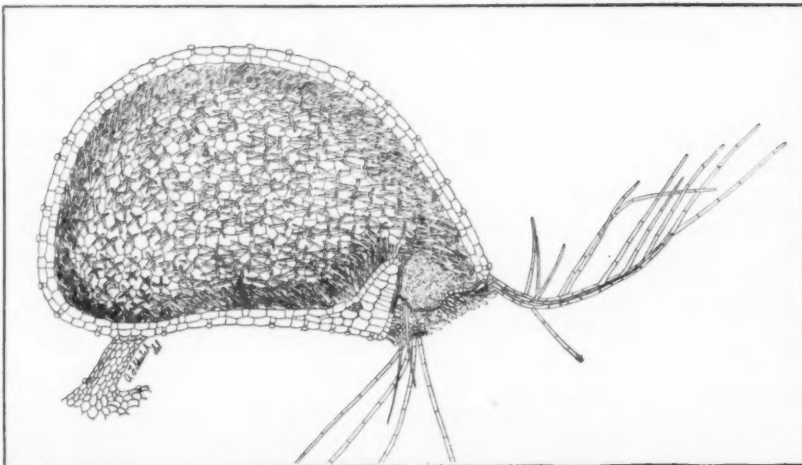
resetting of a sprung bladder, but do not prevent the springing of a set bladder, and this is considered sufficient proof that the springing of the trap is a purely mechanical process, although the setting of course involves the activity of living cells in absorbing water from the cavity.

**T**HE prey of the bladderwort may include almost any of the animalcules which swim about in its native pond or ditch, and are at the same time small enough to pass through the orifice of the bladder.

Various small crustaceans, wheel-animalcules, eel-worms and infusorians constitute the most frequent prey. Mosquito larvae are often caught, and there are records of the capture of wrigglers which were so much longer than the bladder that they could get inside only by coiling up.

Occasionally a vertebrate falls prey to the carnivorous plant. There is extant a picture of several tadpoles being swallowed head first by as many bladders, and we have an isolated record of a school of newly-hatched roach fish which had an unfortunate encounter with the bladderwort. Some of the small fry were held prisoner by the head or tail, others by the still-attached yolk sac—surely a bizarre sight!

The number of animals held prisoner by a single plant at one time may be enormous. A large plant of the greater bladderwort with a combined length of main stem and branches of seven feet, bore approximately 14,000 bladders. The number of small crustacea in each of ten bladders ranged from six to 22, and it was estimated that the entire plant contained about 150,000 of these animals, in addition to numerous creatures of other kinds.



A BLADDER WITH ONE SIDE CUT AWAY

*This makes clear the peculiar structure of the valve at the right; also the four-armed hairs which line the inner wall. Once caught, the insect is digested by secretions from the bladder.*

# Calculating Orbits

*How the Astronomer Works Out the Orbit of a New Planet.  
There Is Still Work Enough in Sight to Keep  
a Single Expert Busy for Ten  
Thousand Years*

By HENRY NORRIS RUSSELL, Ph.D.

*Chairman of the Department of Astronomy and Director of the Observatory at Princeton University  
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington*

WE told last month of the way in which asteroids are discovered, almost by machinery with the aid of photography; and something of the hard work which follows for the astronomer before he has his asteroid fairly caught—that is, before a reliable calculation of the orbit can be made. Most of the processes which the investigator follows in such work were, we hope, made fairly intelligible, but at one point a direct appeal to faith was made when it was said that from the observations of the asteroid its full orbit might be calculated. How such a feat can be performed doubtless puzzles the layman. Indeed the calculations which must be made are so long, and in practice so complicated, that even the advanced student who has spent a week in reading the theory and a fortnight in calculation (mainly in correcting his own mistakes) may well “fail to see the woods for the trees.”

THE general notion of the process is, however, not hard to understand for it may be illustrated by a simplified case. Suppose that the orbits of the planets were circles instead of ellipses. It is very easy to see that in this case two observations of a planet would suffice for the calculation of its orbit, and just how the work could be done. A single observation tells us where the planet appeared to be in the heavens—that is, that at the moment of observation it lay in a certain *direction* from the Earth—but gives us no information as to its *distance*.

We may represent this graphically. The size of the Earth's orbit, which for the moment we treat as circular, is already known, as is also the place which the Earth occupies in its orbit at any given moment. We may therefore draw this orbit as in the illustration on the opposite page and mark on it the point *E* at which the Earth was situated when our observation was made. Let us next draw a line *EF* in the proper direction from *E*. Our observation tells us that at the moment the planet lay *somewhere* on the line *EF*, and that is all. So long as this observation stands alone we cannot tell

whether the planet is near or distant.

But if we have a second observation we can answer our question. This observation tells us that the planet was somewhere on another line *E'F'*. Now let us *guess* at the radius of the planet's orbit and draw a circle of the corresponding size, with center at *S*. If this circle cuts the lines *EF* and *E'F'* in *X* and *X'*, these are the points where the planet must have been—provided that our guess at its distance was right. We can measure or calculate what fraction the arc *XX'* is of the whole circumference; and knowing

find that for this distance the period comes out too short for Kepler's law. We have now “bracketed” the true solution and a few more tests will lead us to a distance *SP* which gives exact agreement. The orbit of our planet is thus determined.

For a real planet moving in an elliptical orbit this simple method of calculation would not give accurate results, but a rough orbit calculated in this way is often of practical use in enabling two computers to predict roughly the position of the planet for a month or so subsequent to the discovery, and also well enough to enable observers to photograph it again when desired.

THE calculation of the elliptical orbit, although vastly more complicated, follows the same general lines, using the principles that the planet must be, at the three given times, on the three lines determined by the observation; and that its motion must satisfy *all* of Kepler's laws. In this case the planet's distance from the Earth is first found (by solving a complicated equation of the eighth degree) and then the orbit around the Sun is determined.

The computations are inevitably long and tedious; but three generations of experts have devised ways of saving labor without losing accuracy. The most rapid existing method is one developed by Prof. Leuschner of the University of California. A computer experienced in its use regards the computation of an orbit as a fair day's work. When the first observations are inaccurate—as too often happens, especially for comets—a great deal of time, labor, and patience may be wasted before the errors are all detected.

When all this has been done and done over again with further refinements two or three times, as observations made in later years come in and the first orbit is found to need correction, one might hope then that the trials of the mathematical astronomer were at an end. But the hardest part has not yet begun.

Jupiter and Saturn, not to mention two other planets, are continually at-



PROFESSOR E. W. BROWN

*Dr. Brown, of Yale, has spent so many years studying the many complicated motions of the moon, that some who are facetiously inclined say that he controls them*

the time between the two observations, we can find by simple proportion the period in which a planet moving at this rate would complete a revolution.

If our guess is right this period will agree with that which is stated by Kepler's famous Third Law, that the squares of the periods of the planets are proportionate to the cubes of their mean distances from the Sun. Probably, however, our guess is wrong. The period may come out, for example, 100 long to agree with Kepler's law. We then make another guess—say, of a smaller radius, *SY*, for the orbit, and

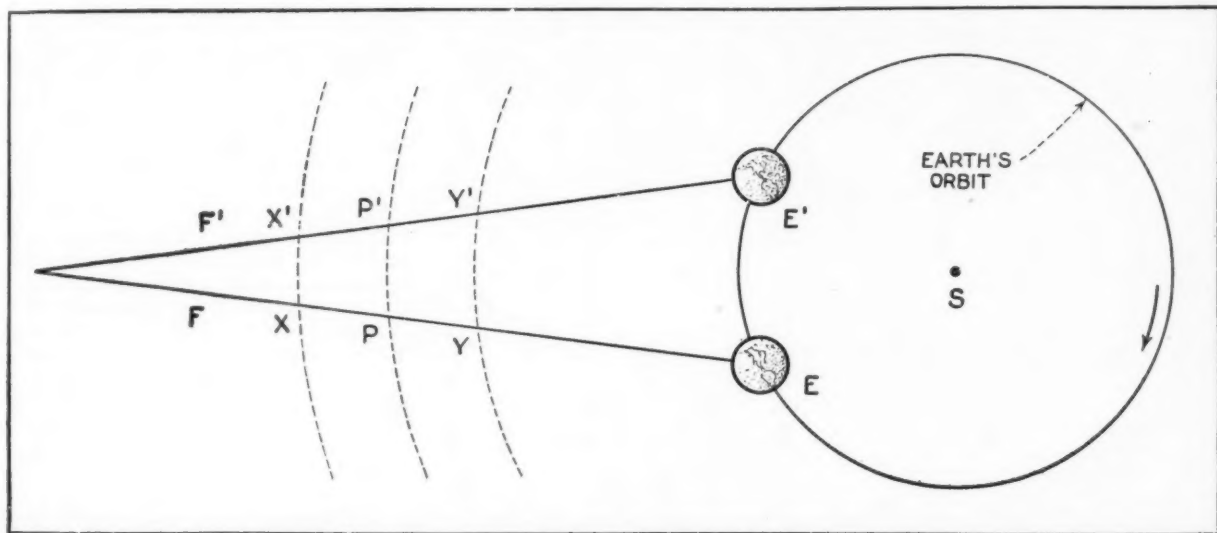
tracting the asteroids. These attractions perturb their motion in such a way that they never follow Kepler's laws precisely. The same thing is true of the major planets; but a body like the Earth which is remote from Jupiter and has near it only smaller planets such as Venus, does not deviate very far from the simple elliptic motion. The asteroids, however, come much nearer to Jupiter, and the resulting changes in their orbits are often very large. To calculate

perturbations, such that when once it had been worked out it would be possible to calculate directly from it where the planet would be at any given past or future date. Such "general perturbations" can be calculated and have been worked out in great detail for the eight great planets and the moon, so that we have "planetary tables" with the aid of which their positions can be calculated for any desired date.

But the computation of such tables

that it can be found close to the middle of a photographic plate centered on the predicted position, and there will be no danger of its getting lost, even if no one looks for it for 20 years at a stretch.

To prepare even such abbreviated tables for a thousand planets is a colossal task, and no more than a beginning has been made. The first requisite for an organized attack on the problem is to know what has already been done for each planet. Such a



HOW THE ORBIT OF A PLANET IS CALCULATED

*S represents the sun; EE' the positions of the earth at the times of two different observations; XX' and YY' are estimated positions of the planet, used in determining the positions PP'. For details, see*

*text. In actual practice, the lines EP and E'P' would usually start upward or downward, out of the plane of the paper. In principle the problem is simple—in actual practice it is very complicated*

them is much harder work than anything which we have previously described. There are various ways of attacking the problem.

We may start with the orbit in which the asteroid is moving at a given date, and then work out step by step the changes produced in it month by month by planetary attractions. The methods by which this is done are fully standardized, and it is not hard to learn to work them. Indeed, they are used in all accurate calculations of orbits such as those of the comets or asteroids which have been observed in three or four different years. But they have serious disadvantages, the worst of which is that in order to predict the orbit and position of the asteroid at any given time—say January 1, 1930—we must calculate the planetary perturbations month by month through all the years intervening between the first observations and this future date; and this is extremely laborious. Moreover, the methods do not enable us to make any long-range predictions by means of which we can foresee what will happen to the planet a hundred or a thousand years hence.

Obviously it would be very desirable to have some general formulae for the

is a prodigious task. The latest of them, Brown's Tables of the Moon, occupied their author for 30 years, in spite of all the aid which skilled assistance could render. The theoretical problems presented by the asteroids, according to Professor Brown, are often much more difficult than those of the Lunar Theory, and the tables of their motion—could such be prepared—would be far more ponderous than the three large volumes of the Lunar Tables. To prepare such tables for each one of a thousand asteroids would tax the resources of a mathematical Utopia. The present age must evidently be content with a more modest scheme.

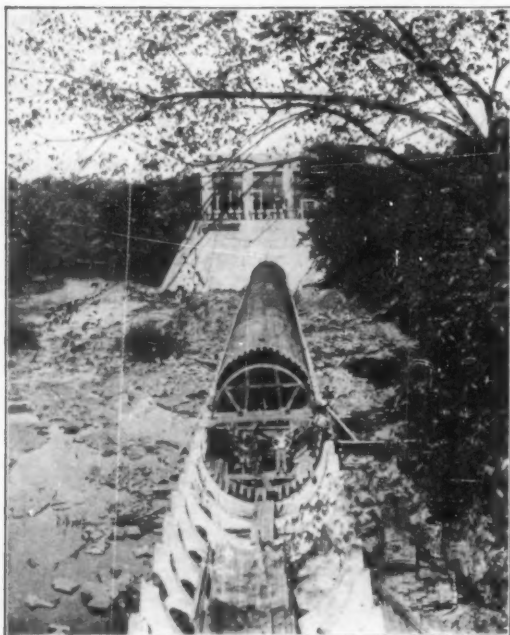
**W**E can not hope to predict the motions of the asteroids as accurately as they can be observed; we may be fully content if we can prepare tables which take into account only the larger perturbations and leave out the multitude of small ones. Such tables will not give the planet's precise position at any given time; they may be out by several minutes arc, owing to the neglected terms. But they will be of practicable compass, and they will always give the planet's place so

research survey is now being carried out by Professor Leuschner with the aid of a corps of assistants. As is usually the case today, in science as well as in business, its results take the form of a steadily growing card catalog, in which the more important data are entered and references to all published work on each planet are indexed for future consultation.

To clear up the puzzles and complicated cases which are continually being met with takes much time on the part of highly trained workers, so that it is not surprising that the cost of the work with the most careful management has been thousands of dollars. How much time and money must some day go into the calculations for which this survey is only the starting point, would be rash to estimate; but it is safe to say that the theoretical astronomer, as well as the designer of great telescopes, could satisfy the wishes of benefactors with no small fortunes to bestow.

**¶** Volcanoes are a never-ending source of interest to the average person. Scheduled for early publication is an article on this subject, complete with many awe-inspiring photographs.





#### WOODEN PENSTOCK

A 14-foot pipe of wood stave construction resting on a flood-proof concrete cradle, built for carrying water to a hydro-electric plant. Compare with size of men

handle greater pressures. Then came the need for still larger conduits and the development of the continuous stave wood pipe of large diameter resulted.

Today pipe lines made of wood are constructed large enough to carry a whole river and to change a natural waterway into a man-made stream which is conveyed over mountains and across deserts in defiance of all natural laws. Pipe-making on the gigantic modern plan is a matter of scientific development. Engineering research has found the correct proportions for wooden pipe lines, according to the re-

quirements of pressure and diameter. The material for a great pipe line is shipped "knocked-down" to the point where it is to be built, and the pipe set up there. All of the material is usually manufactured at a single point, which may be thousands of miles from the place where the line is to be constructed. Smaller conduits, ranging in diameter from two inches to two feet, are produced complete at the manufacturing plant and are assembled by simply joining the ends together. This method would be impractical, however, for the pipe lines 12, 14, and 16 feet in diameter, since the cost of transportation would be prohibitive.

IN the continuous stave method of building the larger pipe lines there is great flexibility in the manner of construction. Since the line is built stave by stave, it may be laid to conform with the ground and the general topography of the country. Viewed from a height, these continuous stave pipes extending through the mountainous regions and across the deserts have the appearance of sinuous snakes.

The staves for the pipes are selected straight-grain Douglas fir, cut and planed in an arc corresponding to the diameter of the pipe required, and the edges are shaped radial to the curve. In assembling, the staves are staggered, no two joints coming together. Circular hoops of steel, with adjustable bolts, hold the staves in place and provide uniform pressure around the circumference of the pipe to prevent leakage. The staves are tongued and grooved to guide the builders, and the end joints are tenoned by means of metal plates. The stave manufacturers purchase green lumber and dry it slowly in their own kilns for from four to five days. It is then carefully

## Wooden Highways That Carry Rivers

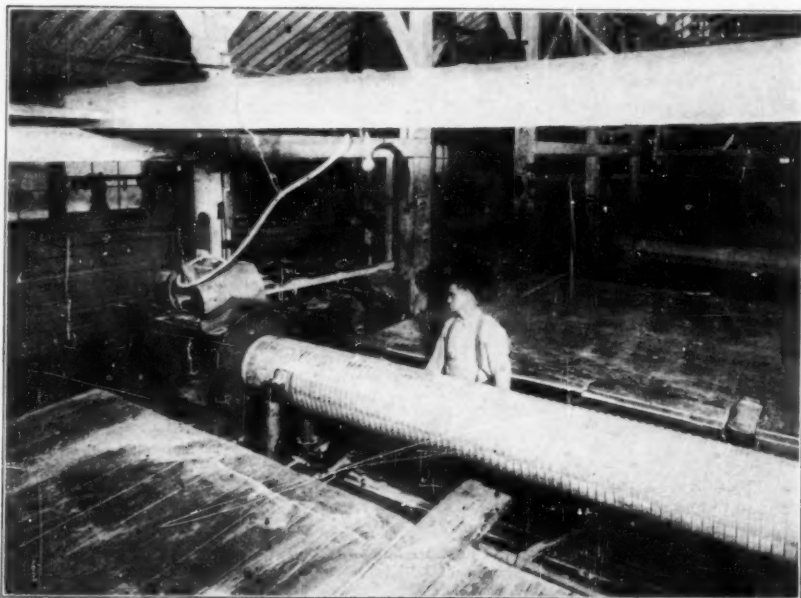
### Wooden Pipe Lines, First Used by the Ancients, Now Built In Gigantic Sizes

By LAWRENCE W. PEDROSE

CONVEYING of water for domestic and industrial purposes dates back to early civilizations. The ancient Romans constructed aqueducts which diverted streams of water to their cities and filled their domestic needs. In more recent times bodies of water have been carried over mountains and plains, far from their sources, and utilized to irrigate deserts or to turn the wheels of industry. These modern engineering achievements constitute one of the romantic pages of industrial history, but it is interesting to note that while many refinements have been introduced, methods have been simplified, and quantity production developed, which combine to enlarge the scope of application—the principle has not materially changed.

THE Romans bored small tree trunks, joined them together, and carried water to all sections of their beautiful cities. Later civilizations used the same method, and as needs grew and domestic engineering knowledge increased, the use of wooden water mains became universal. In later years the bored tree trunks were bound with iron bands to give them strength to

quirements of pressure and diameter. The material for a great pipe line is shipped "knocked-down" to the



#### SMALLER SIZES ARE FACTORY MADE

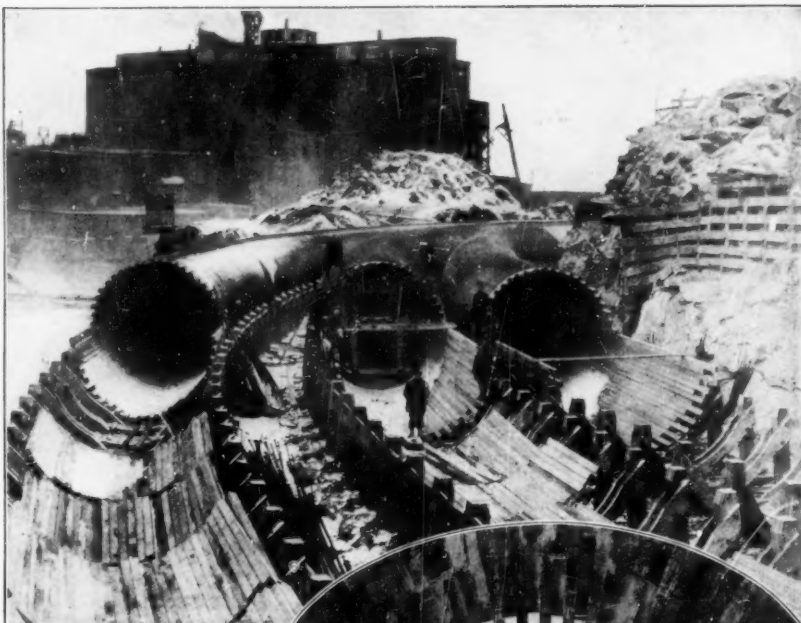
The smaller diameter wooden pipes more closely resemble the old Roman conduits. They are made in the factory, are tightly bound with steel wire, and assembled by joining the ends



graded and put through the sticker machines which, in a single operation, cut the staves to conform to the desired pipe diameter complete with tongue and groove; and then plane them. Then the ends are trimmed and they are again rigidly inspected. The next step is creosoting. The staves are placed in a vacuum at varying temperatures, and approximately eight pounds of preservative oils is injected into each cubic foot of wood. These creosoted staves have virtually unlimited life.

**W**HERE the smaller, wire-wrapped pipe is constructed, the staves are laid by hand, held in place with bands, and placed in a wire winding machine where a heavy galvanized wire is wound round the pipe under pressure. The wire bites slightly into the wood. The pipe is then rolled to an automatic heading machine which puts on the head. The completed pipe goes to a dipping bath where it is given an exterior coating of coal tar and asphalt mixture, after which it is rolled in sawdust. The final step in manufacture is the putting on of the coupling under steam pressure.

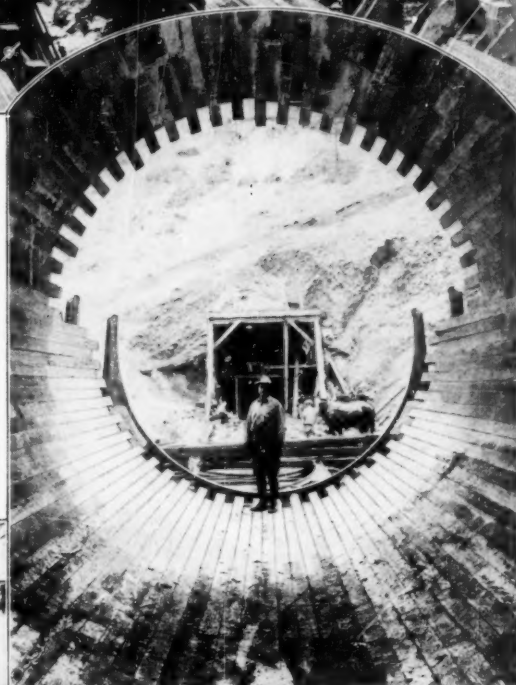
Among recent installations of continuous wood stave pipe of spectacular proportions were a line 16 feet in diameter in California; a triple line of 13-foot pipes which divert, for hydro-electric purposes, the entire flow of the Androscoggin River in New Hampshire; a 14-foot pipe line in Montana; a 9-foot pipe line in northern Canada; a 6-foot pipe line in Spain; a 4-foot installation in Japan; and a 3-foot line in Cuba. How the wood pipe industry aids other



### THREE HUGE PIPES

*These three wooden pipes, each 13 feet in diameter, were built to divert the whole of the Androscoggin River, New Hampshire, for industrial purposes*

industries is revealed by the figures compiled from the recent construction of a four and one half mile continuous stave pipe line for a power company in Colorado. The line required 3,600,000 board feet of lumber, 4,455,600 pounds of steel bands, and



### FROM THE INSIDE

*A 16-foot continuous stave pipe line built for a hydro-electric project in California*



### LIKE A MONSTROUS SNAKE

*Panoramic view which illustrates how closely the continuous stave construction hugs the ground. Winding snakily across country, such pipe lines may carry volumes of water for great distances*

521,933 pounds of malleable iron shoes.

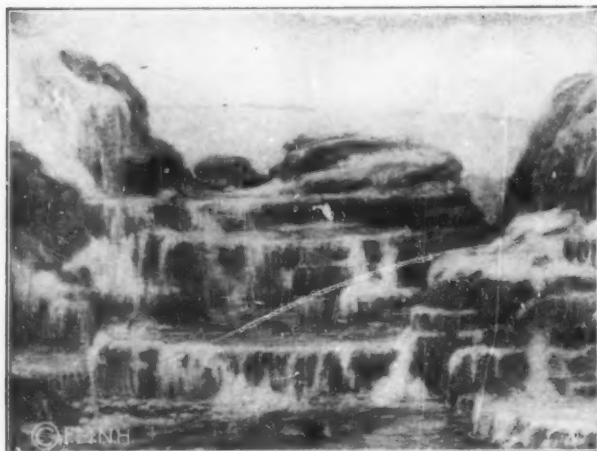
The wood pipe finds a wide variety of uses. While the larger installations are for hydro-electric power projects, municipal water mains, and irrigation systems, the pipes are used widely in hydraulic mining, drainage of mines, steam lines, surge tanks, sewers, road culverts, et cetera. The reasons for the use of wooden pipe lines where great volumes of water must be carried long distances is obvious. Steel pipes, made up of rings riveted together, would be too expensive, and concrete pipe lines, to be strong enough, would have to be very thick and their construction would entail the use of too-complicated forms.



THE EARTH COOLING DOWN AFTER IT WAS THROWN OFF FROM THE SUN

The duration of time since the birth of the Earth, as measured by means of radioactivity (SCIENTIFIC AMERICAN, April, 1928, "How Old is the

Earth?") is at least 1500 million years, possibly 4000 million. The early time depicted above is the lifeless first part of the Archeozoic Era.



THE BEGINNINGS OF LIFE

Pools of blue-green algae, minute plants, still with us today. Remains of their ancestors are the most ancient fossils thus far found



A SEASHORE OF 500,000,000 YEARS AGO

In the Ordovician Period we see great straight-shelled molluscs 15 feet long, ancestors of the modern octopus and nautilus; also trilobites

## New Scientific Paintings Outline the Earth's History

THE first seven of a series of paintings designed to present a systematic outline of the evolution of life on our planet has been placed on exhibition in the Ernest R. Graham Hall of Historical Geology in the vast Field Museum of Natural History in Chicago. The paintings were made by the well-known scientific artist Charles R. Knight, and their production was made possible by Ernest R. Graham, patron of science. Although these seven paintings touch only a few of the high spots in evolution, their total time scope is considerably more than a thousand million years.

Most of us know best the geologic time divisions—eras, periods and epochs—which lie nearest our own times; for example, the Tertiary Period ("Age of Mammals") or the Mesozoic Era ("Age of Reptiles") immediately preceding it. Still farther back we recall the "Age of Fishes," and next

the times when only small, still less interesting animals were on the earth.

As we continue, however, to push the already dim horizons of geologic time back to the ultimate, we once more enter into intensely interesting eras—the very earliest ones during which life on earth doubtless originated. Perhaps the larger part of this interest is due to the fact that the origin of life, like its nature, is a profound but intriguing mystery—and we all love mysteries.

FEW realize how long the early, most primitive eras of geologic time were, or that they occupied fully two thirds of the total life of the earth to date. For example, between the time depicted in the picture at the top of the page and that of the third picture, there was a lapse of roughly 1,000,000,000 years—yet even then life had not gone far on its career of

evolution toward the higher, more complicated forms of the present times.

Geologists divide this inconceivably long duration into two eras, a later one in which there was life (the Proterozoic) and an earlier one (the Archeozoic Era), at some time during whose 500,000,000 years we believe life must have begun. How much of this time elapsed between the birth of the Earth from the Sun and the very first manifestations of life? No one knows. There is no known direct evidence. The soft primitive protoplasm of the living things of that time doubtless left little or no fossil record, and if it did, the record was subsequently all or nearly all obliterated by heat and other potent natural agencies.

Geologists from time to time discover earlier and earlier fossil evidences of life, but as yet these carry us only a small fraction of the way back toward the beginning. Professor J.



#### THE GIANT STEGOSAUR—ALMOST BRAINLESS

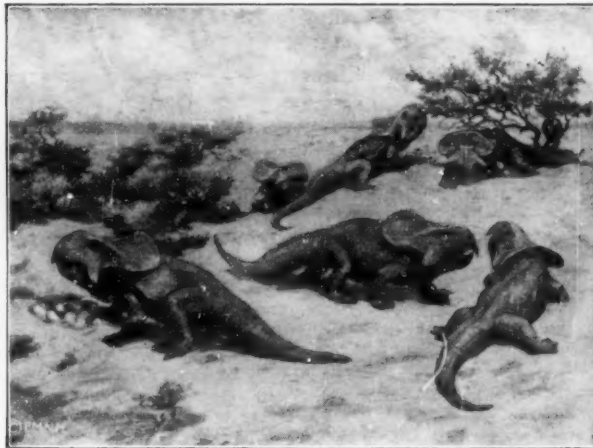
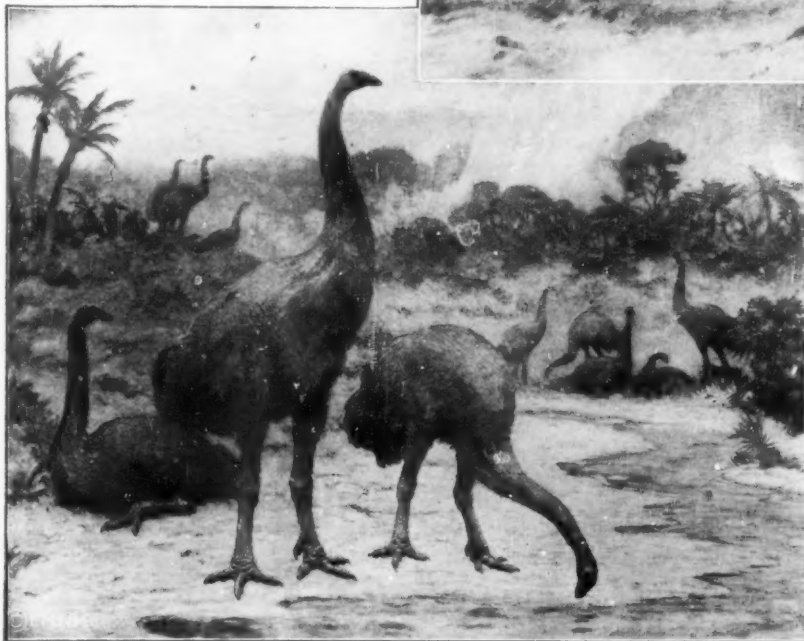
*In the Mesozoic Era, 120,000,000 years ago, the great reptiles were dominant. The great stegosaurus's tiny brain weighed only two ounces*

W. Gruner of the University of Minnesota has discovered, in rocks of late Archeozoic Age, certain microscopic fossils of something resembling the modern blue-green algae which a student's microscope will reveal today in many samples of pond water. Even these and similar evidences have, however, been called in question by Professor J. E. Hawley of the University of Wisconsin who asks us at least to investigate the possibility that they are merely chemical manifestations like those called "imitations of life" which can easily be "created" by mixing ferrous sulfide and water glass, and which exhibit many of the characteristics of living matter but do not live.

Indirect evidence—the widespread

#### ONLY RECENTLY EXTINCT ►

*Giant kangaroos, about the size of a rhinoceros, and great wombats of about equal bulk. Ancient man perhaps saw these*



#### PROTOCERATOPS, EGG-LAYING MESOZOIC LIFE

*The ceratopsian reptiles lived at a later time than the stegosaurus. As time went on they evolved large horns and became extremely formidable*



#### ◄ THE NEW ZEALAND MOA

*This 12-foot bird, which lasted until only a relatively few years ago, brings us up to our own times in the survey of geologic history*

presence of graphite in metamorphosed rocks of Canada; the presence of red (oxidized) sediments proving the existence of oxygen available for life, and other indications discussed in geologies (Schuchert's "Historical Geology," for example)—more than hint that life abounded in and during many of the 500,000,000 years of the Archeozoic Era which are such a mystery and a challenge to us. But such indirect evidences are not the kind that satisfy.

How did life start and what is it? For both of these questions there are scores of hypotheses but little conclusive proof. What science seeks is not more hypotheses but some kind of direct, conclusive, fossil evidence. This we may never succeed in finding.



# Noise

By DONALD A. LAIRD, Ph.D., Sc.D.

Director, Psychological Laboratory, Colgate University  
Editor, Industrial Psychology

*Despite the Claim, Frequently Made, That One Can Accustom One's Self to Work in Noise, Scientific Research Shows That It Lowers Efficiency*

THE human organism has marvelous adaptability. No bad effects can be traced to the adaptation to cold climates or torrid zones, for after a few generations the races inhabiting these regions appear to become perfectly adapted to the extreme conditions under which they have to live.

The United States citizen, however, who moves to the tropics finds dif-

themselves biologically to the change. Is it possible that the gradual increase of industrial, office, and street noises will have like results?

In an effort to answer this question the psychological laboratory of Colgate University is in the midst of a series of experiments which will continue through several years. Data have been gathered from sources ranging from champion typists with a speed in excess of 200 words per minute, to white rats. All indications to date confirm the suspicion that noises may be a more serious problem than the average person is willing to admit.

THE biological harm in noises does not appear to lie in their damage to the ear or auditory nerve, but rather in the fact that noises are an inborn stimulus to cause the fear reaction. Common noises from everyday experience illustrate this fact: The shiver up one's spine when a file or caster squeaks; the involuntary jump at the unexpected report of a pistol; the fear of thunder storms; the fatigue after a noisy railway journey.

Not all noises cause the fear reaction and a small number of people may be exceptions to the rule. As a rule, however, intense noises, or intermittent noises appear to be prime instigators of the fear reaction.

In the cat the fear reaction is indicated by the hairs on the back standing straight up. This is caused

by the contraction of tiny involuntary muscles at the base of these hairs. A similar involuntary muscle contraction is found in human subjects in the fear reaction, causing an increase in muscular tonus or tension. Pulse rate, blood pressure, and breathing are other biological phenomena which may be affected by the fear reaction.

At the University of Michigan a few years ago, for instance, a sleeper was being studied. It was found that when a taxi passed his window in the middle of the night, the noise of the machine caused a rise in blood pressure, even though the sleeper did not awaken.

In experiments upon typists in the Colgate University laboratory it was found that when the noise in the test chamber was reduced by only 15 percent there was a 5 percent increase in output, and that about one fourth less bodily energy was burned up in doing the typing. There are two remarkable things about these findings.

THE fact that so small a decrease in noise by absorbing it with wall panels resulted in 5 percent greater output is probably due to the unreduced noise intensity being just above what may tentatively be called a critical level; that is, before the 15 percent reduction the noise in the test chamber may have been at the point in intensity where it produced



THE AUTHOR

*Standing outside Colgate Psychological Laboratory where many researches concerning industrial efficiency are conducted*

ficulty in living at his previous zest in the hotter surroundings. If he and his descendants remain there long enough, however, they may become as fitted for the torrid conditions as are the natives.

With noise, conditions appear to be somewhat similar. In our present civilization noises have been increasing by leaps and bounds, and there is not much indication that they are going to decrease spontaneously. Can human beings adapt themselves to noises without suffering ill effects?

This may be a very vital question for the future of the race. The civilization of the United States would undoubtedly slump greatly if our climate were suddenly to be changed to that of the Panama Canal Zone; several generations would probably be needed for the inhabitants to adjust



HOW MUCH NOISE ENTERS A WINDOW?

*An experiment to determine the effect of outside noise, performed at Stanford University. The man in the foreground fires a revolver and the intensity of sound is recorded inside the room*





### HOW NOISY ARE MACHINES?

*Checking up on noisy machines in the Hawthorne plant of the Western Electric Company, using an audiometer to measure the noise*

ill effects. This is indicated by the fact that reducing the noise still more did not affect the output figures. Apparently there is a critical point in the intensity scale of noises above which the fear reaction and possibly other effects are found, and intensive experimental work is being undertaken in the laboratory to discover these critical points for various noises and individuals. So far the indications are that most city and office and factory noise intensities are above this critical point.

The second remarkable finding is related to the consumption of about 25 percent more bodily energy, due to working under the noisier conditions. The energy consumption in calories was determined by collecting exhaled air and analyzing it for oxygen consumption, carbon dioxide production,

and total volume. Dr. John J. B. Morgan, of Northwestern University, discovered a few years ago that when typists were working under noise they exerted increased pressure upon the typewriter keys. This would not, however, account for an increase in energy consumption of the body of the magnitude we obtained. The difference is therefore due to the fact that under the noisy conditions bodily energy is dissipated by a general tenseness of all the muscles of the body. This is the exact reverse of relaxation and is fatiguing, and it saps energy unnecessarily.

In order to obtain standards of noise intensities for duplication in the test rooms in the Colgate laboratory, a survey has been made of noises in Chicago, Boston, and New York. Subway trains have been discovered to be



### A NOISE-PROTECTED OFFICE

*A special window ventilator cuts off most of the outside noise, a rug absorbs inside noise but the bare walls largely offset the benefit*

the noisiest means of travel, the noise being equaled only by an unmuffled airplane motor.

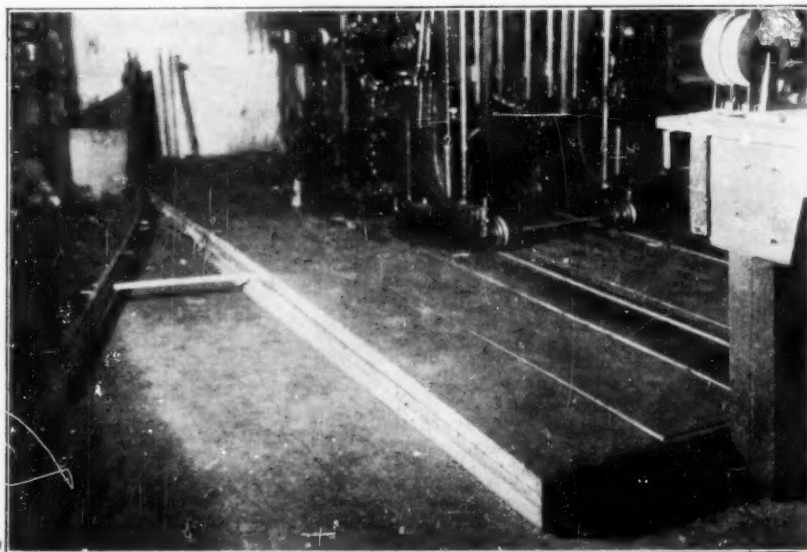
Until about two years ago it was not possible to measure noise intensities. The intensity of illumination from sources of light has been measured for years in foot candles, but until the Bell Telephone Laboratories developed the audiometer which was used in our surveys, no similar practical means existed for measuring noise. This instrument measures noise intensities on a scale from 0 to 100, 0 being a just inaudible intensity, and 100 an intensity great enough to make the ear drum tingle on the verge of pain.

We have found very few places where people work that are below an intensity of 50 units. The laboratory noise intensity that cut into the output of typists by 5 percent and into rigorous mental work such as executives think they do by 30 percent, was of a noise intensity just below 50 units.

**I**N a shopping section such as State and Madison streets in Chicago, the average intensity is 60 units, although at times during the day it went to 50 as a low mark. At times the intensity reached above 70, when surface cars were passing.

Surface and elevated cars contribute the most to city noises. Busses, automobiles and taxis yield around 50 noise units. Horse-drawn drays are almost as noisy as surface cars, especially if they are being drawn over brick or cobblestone paving.

Subway trains make a racket of from 75 to 80 noise units—about 10 or 15 units greater than surface cars. This is rather severe on passengers, but does not contribute so much to street or office noises as the surface cars, since most of the subway noise is kept below ground.



### LOCALIZING NOISE MADE BY MACHINERY

*Less noise is transmitted from this printing press because of a special mounting constructed of wood and noise-absorbing material. This cuts off direct vibration from transmission to the floor*



### HOW NOISY IS FLYING?

Taking an audiometer on a hydroplane at the Great Lakes Naval Training Station

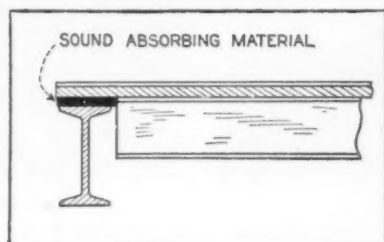
Some factory operations subject the workers to a continuous noise of 85 units. Intensities such as this are inexcusable in plants, for they could easily be reduced to a considerable extent by employing practical methods which will be pointed out shortly.

Most city dwellers are "innocent bystanders," so far as noise is concerned. No matter how quiet one attempts to be, noise will pour in through an open window, or even filter into the house or office through the crevices of the window. In a courtroom on the eighth floor of the County Court Building in Chicago, for example, with the window closed and no noise being produced in the room, an intensity of 25 units was recorded at the judge's bench. With one window half open this intensity was instantly raised to 35 units—an increase of 40 percent! The intensity of 25 units with the windows closed was not due to surface cars, as the window exposure was toward a street with only motor traffic.

OUR present American civilization is noisy, not only because more machines are being used, but also because the type of building construction now used tends to *prolong* and *transmit* noises. A bare plastered wall, for example, reflects noises better than a mirror reflects light. If you clap your hands together in a bare plastered room, more than 95 percent of the noise will be reflected from the wall. The sound of the hand clap will therefore persist for several seconds. This phenomenon of reverberation causes noises to be built up and retained "alive" in a room in such a way that their intensity is actually increased. If you clap your hands more than once, the noise generated by the second clap will be reinforced by the "reverberatory ghost" of the

first hand clap, the ghosts of the first and second reinforce the third; and so on until in the right kind of room (which, in fact, is the *wrong* kind) one person applauding himself can equal a whole audience.

If rugs are placed on the floor the reverberations will be cut down greatly. Further, if the walls were to be covered with heavy velvet drapes, absorption would be great enough so that the sound energy of each hand clap would

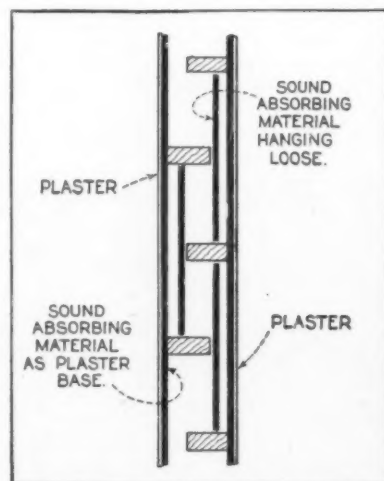


### BUILDING FOR QUIET

Transmitted noises and building vibration can be cut down by this type of construction

be promptly absorbed and turned into minute quantities of heat and the hand claps would stand out in sharp individual staccato, not producing the mild roar they did in a reverberant room.

The practical control of noises does not consist in trying to keep the children quiet and in throwing out modern machinery, but largely in having an adequate amount of sound absorbing materials in work and living



### BATHROOM PARTITION

Plan view of studding and walls. Studding should rest on sound-absorbing material

rooms. In many instances, however, noises can be cut off at their source, as by oiling a squeaky hinge, weather stripping a window that rattles, or adopting street cars with roller bearings and aluminum bodies which are quieter than the old construction.

In acoustical engineering the open air is taken to represent one unit of

noise absorption per square foot. As soon as the subway trains of New York come out into the open air at about 125th street, for illustration, the noise the passenger hears is immediately reduced by more than 13 percent, due alone to the absorption of the open air.

The noise absorption value per square foot of common materials, an open window being taken as unity (for example, one person in a room has an absorption value equal to that of 4.7 square feet of open window) is as follows:

Plaster.....	.03
Varnished wood.....	.03
Linoleum.....	.03
Glass.....	.027
Concrete.....	.015
Carpet rugs.....	.20
Brick wall.....	.032
Cretonne cloth.....	.15
Akoustilith (artificial stone).....	.36
Hairfelt two inches thick.....	.40-.60
Insulite, half inch thick.....	.31
Flaxlinum, one inch thick.....	.55
Acousticeletex, one and one half inch thick.....	.70
One person.....	4.7

Much noise can be kept out of a home by the use of window ventilators designed to keep out noise while air is still admitted. Locating the house so that it is off the beaten path followed by trolleys and motor transportation also adds a restful quite.

NOISE that is transmitted through floors and walls of a building can be reduced only by special construction in which floors are floated on absorbing material and by the generous use of noise absorbers, as suggested by the preceding table.



### CHICAGO NOISE

With an audiometer, the noise on a busy corner in Chicago is being recorded



CUTTING AND UPROOTING OLD GRAPE VINES

*This attachment cuts old grape vines 18 to 24 inches below the surface and pulls them out. Its record for one afternoon is 3300 old vines*



DUSTING FRUIT TREES WITH INSECTICIDE

*Equipment developed for attachment to the tractor that does the regular work of cultivating. It can be attached or removed in a few minutes*

## Engine Ingenuity

### *Novel Means Have Been Devised for Using Tractors to Lower Costs*

WHEN tractors first began to lift the load of labor from the shoulders of the farmer, they were used only to plow and pull a combination harvester. They replaced only a few of the horses. Since then, however, their adaptability to other tasks has led to their use for belt work, cultivating, seeding, and practically every kind of farm work. Many clever ways have been devised for making the tractor do not only the horse's jobs but also many that the horse cannot do, or that are too big for him.

In asparagus fields, a powerful tractor pulls a special pulverizer that leaves the soil in powdered condition. A tractor draws special machinery that ridges the soil and does the seeding in spinach fields. The ridging is necessary so that furrows may be flooded. Fruit trees are dusted by the same tractor that does the regular cultivating and plowing. In Mexico, Señor Don Angel Torres plants sugar cane by

tractor power. Two furrowers dig the trenches, two spouts convey the cane joints to a depth of 20 to 24 inches, and two men feed the cane to the spouts. Grubbing rocks is a common chore for tractors. Loose stones are dragged away by chains while imbedded ones may be loosened by a subsoiler.

One planter built a closed cab on his tractor for protection from wind and the dust stirred up by operation in the field. Another built a shield on his in order to protect the driver from overhanging branches. Mr. M. P. Brooks of California operates a tractor equipped with bean cutters capable of cutting six rows at a time.

The first time around a rice field with a pulled binder flattens much rice. To prevent this, a push binder has been developed. Libby, McNeill, and Libby have developed a new type of subsoiler drawn by a tractor that



AN ARMORED TRACTOR

*Shields for the driver and tractor treads to allow work under low-hanging branches of trees in citrus groves*

straddles the rows of pineapples on their large Hawaiian fields. The subsoiler breaks the soil to a depth of 18 inches. Chisel cultivators, clod breakers, uprooters, and other special types of machinery, drawn by tractors, have been developed for use in vineyards. In one large vineyard, a tractor is used to haul cars loaded with grapes. What appears to be a locomotive is a tractor on flanged wheels operating over a narrow-gage track. These and a variety of other farm chores are now being done by tractors.



GETTING RID OF STONES

*Sometimes rocks are loosened by a subsoiler or a heavy chisel; sometimes a chain is attached and they are towed away by a powerful tractor*



PLOWING A TWELVE-FOOT ROW

*A two-way plow with a "middle buster" and four 10-inch mold-boards at each side controlled by extra men. It is used on a California ranch*





#### WHERE ONCE THEY ROAMED IN THOUSANDS

A small herd of animals in Buffalo National Park, Wainwright, Alberta. To avoid congestion in this relatively small park, several thousand buffaloes have been moved in the last three years to the Fort Fitzgerald district and released to mingle with the wild herd

## The New North

### *Will Canada's Immense Northwestern Area of Untouched Prairie, Forest, and Tundra See the Next Great Wave of Economic Development?*

By E. L. CHICANOT

THE economic north of the American continent is periodically changing. At one time it was held to stop short of the international boundary between the United States and Canada, and authorities dogmatically stated that there could be no worth-while production north of this. Now, with the great plains of the prairie provinces become one of the world's greatest agricultural territories consistently producing the world's prize wheat and accounting for an ever-widening diversity of crops, attention has come to center upon the Peace River country, 600 miles or so north of the Canadian border, (see map, at A) as being potentially a greater farming country. And already the eyes of economists are strained yet farther north and look right into the Arctic circle to see there a vast, rich, productive expanse of land.

Canada, with as yet but a small population sparsely scattered over her broad domain, anticipates a time when what is regarded now as her economic

area will be adequately settled and productive and the search for new wealth and new methods of obtaining a livelihood will take men ever farther northward. The Dominion is making preparations for the development of her sub-Arctic wastes into a territory comparable in its productive capacity to others of her present divisions. It

pictures this now almost uninhabited vastness as the greatest preserve of herbivorous animals in the world, constituting a source of meat supply such as has never been known—an asset of tremendous national value.

This is not nearly as fantastic as it sounds. In fact it is eminently feasible.

Because of the comparatively small amount of exploratory work which has been undertaken and the brief publicity this has received, the most lamentable misconceptions exist concerning this tremendous hinterland which penetrates above the Arctic circle and reaches almost to the pole. Popular imagination pictures it as a bleak, frigid, and barren territory, continually buried under snow and populated by a few scattered bands of Indians and Eskimos who take harvest of the furs, its one resource. That it might be a valuable adjunct to the rest of the Dominion of Canada has occurred to few.

As a matter of fact this region experiences bright and warm summers and produces a luxuriant vegetation capable of sus-



#### FOR BUFFALO TRANSPORTATION

The river steamer and scow used in transporting buffaloes from the railroad terminus to their new northern home

taining almost unlimited animal life. The rudest survey has revealed the existence of other resources, the extent of which cannot even be guessed. It is significant that the few men who have anything like an extensive knowledge of this region are most enthusiastic advocates of its conservation and development.

One of the obvious resources of this great area of which so little is known, one which has no place in the picture of snow-swept stretches, is its timber. Up to well within the Arctic circle are to be found quantities of spruce, tamarac, jackpine, poplar, larch, birch, and willow, all of good size and in commercial quantities. In the Mackenzie district (see map, at B) spruce attains a height of from 80 to 100 feet and logs have been cut averaging 40 feet long and 10 to 18 inches in diameter. The newsprint paper industry has already made a start upon the pulpwood supplies of the Prairie Provinces.

**T**HIS vast territory has come rather more to public attention since the war. This is due to other phases than its Eskimos, its Indians, and its fur harvest. In the years immediately following the armistice, the search for oil in western Canada took drillers up into the Mackenzie River basin, well within the Arctic circle. There they were rewarded with a strike at Fort Norman, (see map, at C) 1500 miles north of Edmonton, which

is awaiting the transportation and other developments of the future. Following this, iron ore was discovered in the Mackenzie River basin and on the shore of Lake Athabasca (D)—important finds which must await future



THE PICTURESQUE BUFFALO

Once near extinction, this animal with which American history is closely interwoven, is staging a come-back

utilization. The most desultory prospecting, carried out mainly by airplane, has revealed the mineral resources of the area as extensive.

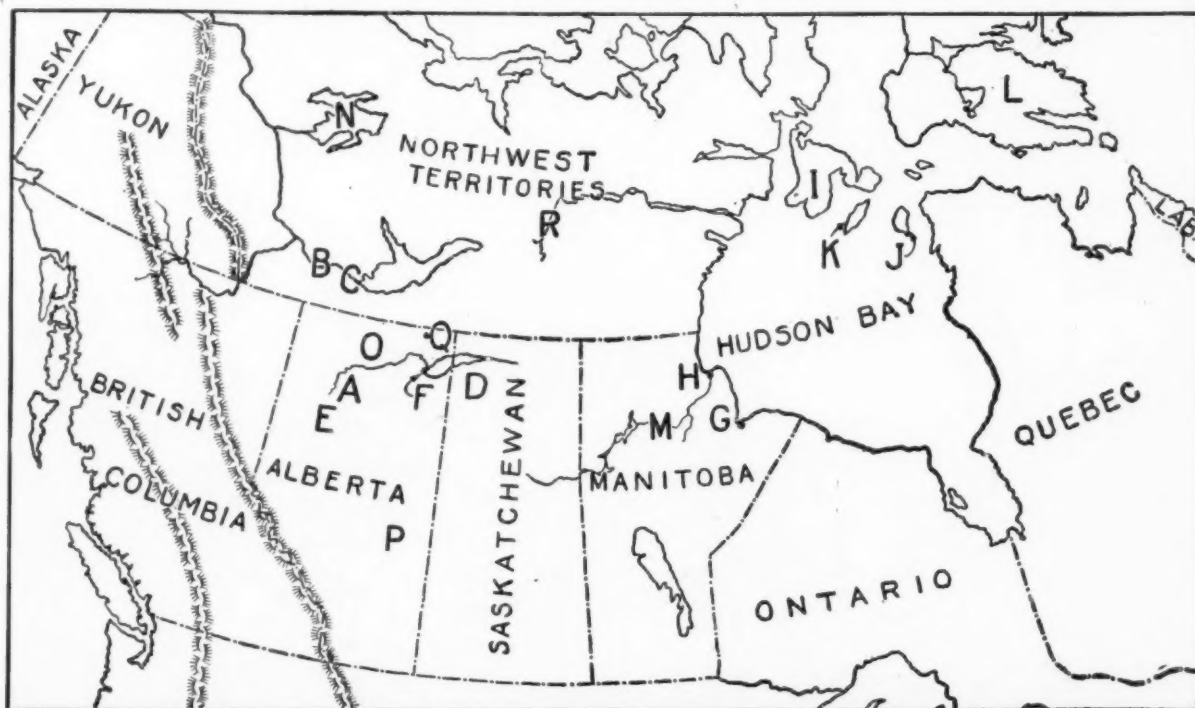
More recently, forcible attention has been drawn to the agricultural possibilities of the Far North. In 1926 the prize-winning wheat and oats at the Chicago Hay and Grain Show came from a point in the Peace River country, 600 miles north of the border. This recalled to memory the forgotten fact that in 1893 the prize winning wheat at the Chicago World's Fair came from the Shaftesbury Settlement, (E) 15 miles from Peace River Crossing, and that as long ago as 1876

wheat grown at a mission at Fort Chipewyan (F), to all intents and purposes within the Arctic circle, secured first prize at the Centennial Exposition at Philadelphia.

Just how far north the limit of successful agriculture will eventually extend one would scarcely venture to say, since it is very evident that the wheat belt is steadily being pushed northward. The evolution of marquis wheat at the time the Canadian prairies were first being settled, reduced the time between seeding and harvesting from 120 to 110 days and definitely expanded what was considered the wheat belt at that time.

**T**HE development of garnet wheat which ripens 10 days earlier has, according to the best authorities, pushed back the northern boundary of agriculture from 100 to 150 miles, bringing all the meadow and lake country from Port Nelson (G) and Fort Churchill (H) to the Rocky Mountains within the dominion of the plow. Now Herman Trelle, Peace River wheat and oats champion at Chicago in 1926, has produced a wheat which can be sown later and yet ripens 18 days earlier than present varieties, thus thrusting the limit yet farther north.

Looking into the future, Canada believes the time will come when exploration and exploitation of the vast stretches even beyond the wheat belt will become necessary or advisable, and it is her conviction that the de-



#### WHAT WILL ITS FUTURE BE?

Will this great territory where wheat is grown in vast quantities, and buffaloes, musk-oxen, and reindeer are encouraged to multiply, become the factor it promises to be in world economics? There are a great many things in its favor. The text refers to the lettered areas



#### A POTENTIALLY HUGE MEAT SUPPLY

*A herd of reindeer. Canada has followed the lead of the United States in introducing this animal as a meat producer. Already reindeer meat is being sold in many American cities*

velopment of the varied natural resources of the territory will depend upon the existence there of a robust native population and an abundance of wild life. Accordingly, the Dominion is taking early steps to assure these, through the protection of those animals upon which the sparse population of that territory now depends, and also through the introduction of others which it has reason to believe will thrive there.

It was shortly after the end of the war that attention was forcibly drawn to the diminution of wild life in the sub-Arctic regions, strikingly indicative in itself of the increasing exploitation of that area. A government commission of trappers, Hudson Bay officials, mounted policemen, and other frontiersmen was appointed, and it is largely upon the recommendations contained in their report that the government has been working.

**I**MMEDIATELY three islands in the northwest territories, Southampton (I), Mansel (J), and Coats (K), each with an abundance of forage, were set aside as perpetual breeding ground for herbivorous animals existing in the area, or those which might be introduced later.

The introduction of reindeer into the territory, especially after the successful experiment of the United States in Alaska, was recommended and considered. This, supported by the explorer Stefánsson who probably knows more about this region and its potentiality than any other man, stimulated private enterprise. One company brought in from Finland 700 animals to be grazed on Baffin Land (L), there to be attended by their Laplander shepherds. Another secured a Dominion concession of 75,850 square miles of grazing in the Barren Lands north of the Churchill River (M), and planned

to drive 1500 reindeer across from Alaska. These enterprises would appear to have proceeded without sufficient preliminary investigation and study, and their lack of success is believed to be due to a choice of territory deficient in the moss suitable for pasturage.

Authorities believe, however, that the project is feasible in the territory and the government is seriously planning to stock the Mackenzie River basin with reindeer, and is making most careful investigations to this end. The Porslid brothers of Denmark, men of wide experience in the Arctic, were engaged some time ago by the government to investigate thoroughly all conditions entering into the proposed attempt. They went into the north country in June, 1926, and did not come out again until the spring of

1928. They spent eight months investigating the reason for the successful introduction of reindeer into Alaska and worked down the Mackenzie River and Great Bear districts (N), comparing conditions with those of Alaska. Should their report to the Dominion Government be favorable, 2000 reindeer will be introduced into the area.

In the post-war period, the government's efforts at developing great meat producing herds in the far north were aided from a most unexpected direction. In 1921, a government survey party in the uncharted areas of northern Alberta (O), encountered a herd of several hundred buffalo, an animal which was believed to be extinct in its wild state. Steps were immediately taken to protect them, and their range grounds were declared a sanctuary. A park of some 17,300 square miles in extent was created, cabins erected, and wardens were appointed to supervise and protect them.

**S**UBSEQUENTLY a brilliant solution to the problem of congestion of the domesticated herds of the national park in Alberta occurred to the government which had for some years been killing off a number of animals each year to keep the herds down to reasonable proportions. It was decided to transfer a number of young and vigorous buffaloes raised on the reserve, to the wild sanctuary and turn them loose with the untamed buffaloes there. In the past three summers, some 7000 animals have been moved, at considerable expense and tremendous trouble, by train and river barge over the hundreds of miles from the Wainwright Park (P) to Fort Fitzgerald (Q) on the Peace River and turned loose to mingle with



#### CORRALLED AWAITING SHIPMENT

*When it came to shipping the buffaloes to new locations where they would have a greater range, many problems were encountered. Here the animals are kept until a full shipment is gathered*



the wild herd there. The government reports the experiment a complete success, rangers declaring the animals to be in excellent condition and their numbers increasing.

It is possible to look confidently forward to the steady increase of these northern buffalo herds until their expansive ranging grounds will reproduce to an extent the conditions which the pioneers farther west found. Under this protection a vast source of meat can be built up. Even before the transfer, when the overcrowding of the national park necessitated an annual slaughter, buffalo meat was on the Canadian market from coast to coast in competition with beef, and it is not too much to anticipate a time when this food of America's pioneers will be feeding not alone millions of Canada's future population but other millions far beyond its confines.

**P**ROBABLY the most valuable animal of the sub-Arctic regions is the musk-ox. While the development of the buffalo herds was formerly problematical, and that of the reindeer still is, to some extent, there is no question as to the adaptability of the musk-ox to the region or of his superior value.



#### FOR FOOD AND CLOTHING

*The musk-ox is invaluable to the region since it provides both food and clothing. Canada has established a sanctuary for this animal which is one of the hardest of the meat-producing animals*

He is peculiarly and essentially an animal of the sub-Arctic where he has always thrived and can be expected to thrive indefinitely under adequate protection. The musk-ox is, in fact, one of the most wonderful and potentially useful of the Dominion's big game ani-

mals, being huge and strong, exceptionally free from disease, and capable of defending himself against all the menaces of the wild except man. Its flesh is excellent and its pelt extremely valuable. The splendid ability of the animal to rustle food through the winter obviates the semi-annual migration which allows other big game animals to be attacked by their enemies and renders them difficult to find, as is the case with the caribou.

The musk-ox is invaluable to the area, since it provides both food and clothing, and is certain to be an important factor in the development of the territory.

**R**ECENTLY a sanctuary for this animal was established in the valleys of the Hanbury and Thelon Rivers, (R) east of the Great Slave Lake. This area contains 15,000 square miles encompassed in a district 200 miles long and 75 miles wide. This special section was selected because it has been reported to contain some of the remaining musk-ox herds and is without trading posts or permanent residents, being, in fact, a sort of no man's land between the Indian and Eskimo hunting grounds.

Under the plans that are being gradually elaborated and due to the enforcement of rigid protection, a new and a great north is developing. The vast sub-Arctic tundras which have long been regarded as desolate wastes supporting only a few scattered Indians and Eskimos who live precariously upon the fur harvest, are being transformed into a great food preserve. It is believed to be destined in the future to compel world consideration as a new economic division. Possibly some day it will be as renowned for its meat as the area to the south is famous today for its wheat. Some day perhaps, it will supply the world.



#### HARDY HERDSMEN FOR HARDY ANIMALS

*The United States first introduced reindeer into Alaska a few years ago. The small herds of those early days have multiplied so rapidly that now there are several hundred thousand of them*



TYPICALLY DOMINICAN

Photograph typical of forest life, vegetation, and rocky stream beds of the tropic island

ON a calm morning in November, 1493, the sudden, rapid dawn of the Indies found Columbus and his little fleet close to a rugged, volcanic island in the Caribbean. This came as no surprise to the great navigator, for the story has it, that during the previous night he had ordered the ships to proceed under very light sail, and had issued unusually large portions of food and water to his grumbling crews. So accurate had his calculations been, that he had made this windfall at the very time he had planned to do so; and so it came to pass, that on this soft, glowing morning, the towering, jungle-covered mountains, with their caressing rain clouds loomed purple and blue and emerald before the astonished crews.

NO more beautiful sight had these rough adventurers ever beheld. A gem of loveliness was before them which must indeed have softened even their battered senses into appreciation. At any rate, Columbus himself saw the glory of this isle. He sailed around it, but did not land at first, fearing the fierce Carib cannibals; and then because of the day, he reverently named his prize Dominica.

Hundreds of years afterward, fate brought me to Dominica also. That first time, I saw but an hour of her, but that brief visit cast a spell that filled me with the strongest emotion for this island, and filled me also with a desire to penetrate into those mountain jungles and rain canyons, to explore her caves and volcanic fissures. There, too, were strange, living creatures, with

still stranger secrets regarding their lives and adaptations.

All, undoubtedly, was exactly today as it had been hundreds of years before, when Columbus sailed around the island. I could, then, allow myself the privilege of discoverer, at least as far as these secrets of the wild were concerned, and so after years of hoping and planning I found myself at last in the heart of this paradise, surrounded by magnificent forests and jungles, living in the cool shadows of cloud-capped hills and mountains,

lulled to sleep by night to the songs of tumbling streams and brooks, bathed alternately by day with tropical sunshine or deluges of warm rain drops, and always inspired by the strange songs of new birds and the beauty of my surroundings.

The name Dominica became meaningless to me for everything, almost, that I found and investigated possessed a strange or unique story. Thus in my mind it gradually became "Anomaly Island," and thus it remains.

EVEN the first white men who set foot upon this land found to their amazement that the Caribs were divided as regards their language. Thus the men spoke quite a different tongue from that of the women; and here was an anomaly at the outset.

We know now that originally Aruac Indians peopled these islands. They were not a very powerful or war-like people and were doomed to a strange fate. When the fierce Caribs commenced to explore the seas beyond their mainland homes in South America they naturally found the islands, which we call the Leewards, and considered them rich and easy prizes. As they always practiced extermination of the men upon any conquered tribe and took their women for their wives, it is easy to understand the dual linguistic condition the explorers found. The point

of greatest significance is, however, that this fact which so bewildered Columbus and his men proves very plainly that the Aruacs must have been conquered by the Caribs within the lives of the existing generation.

Coming back to the present, we find that the Caribs were never conquered by the whites. They still occupy a reservation on their beloved island for which they fought so valiantly and with their king, Jolly John, who is a personal friend of the author, they live peaceably but unconquered. And thus we record another anomaly.

WHEN one observes carefully the astounding vegetation of this island, realizing that here is to be found every type of plant from moulds and lichens up through the ferns to flowering plants, and that the forests, with their giant trees and endless parasitic forms are among the most magnificent in the world, it seems almost incredible that such an array of living things could have sprung into being upon a mass of inhospitable lava such as the island must have been in the beginning.

Even today there are fissures in the mountains that breathe forth bitter fumes, while a great boiling lake steams and sputters in the mountains, giving certain proof of the real nature of things below the surface. There are in Anomaly Island no rocks or minerals as we usually think of them. Streams cut their way down through boulder-studded lava and volcanic debris, but

all this material is comparatively soft: that is the whole secret of this jungle that has grown to such glorious maturity.

Lichens, those strange flat rock plants, are the forerunners of soil. They thrive upon the soft boulders of Dominica, sending their microscopic rootlets into the tiniest cracks. Here they grow and expand and pry off minute fragments of the mineral matter. In



JOLLY JOHN

King of the Carib Indians, and a firm friend of the author

turn, their bodies die and rot and thus are mineral and organic matters combined in a preliminary soil that will support ferns and other higher plants which cannot live on rock alone.

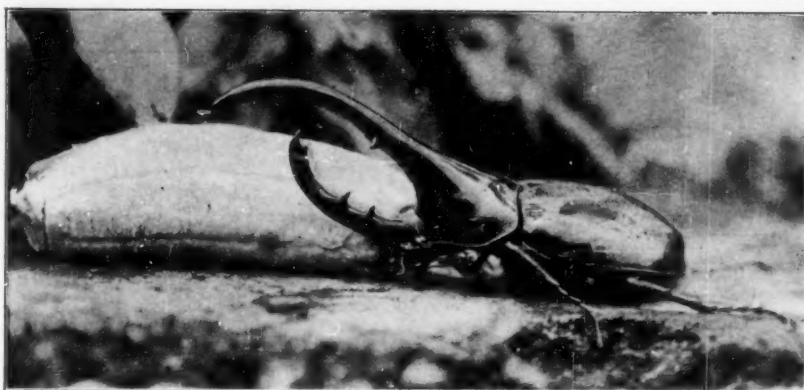
Dying and rotting, dying and rotting, always after life and growth—thus is the soil built up. We must remember also that rain plays its part. It helps the rotting process and its carbonic acid gathered from the air helps to dissolve the rocks or lava.

**I**N Dominica there is a tremendous annual rainfall, probably 300 inches in the highest mountains. Soil forms quickly and vegetation thrives in the humid warmth. Rotting and return to the earth is very rapid under these conditions. Thus has the thick rich forest soil been brought into existence upon the bare lava of the island.

Along the coast of the island and 150 feet above the level of the sea I found marine deposits in the cliffs, proving either a former uplift of the land or the subsidence of the sea. In these deposits were the shells of both univalve and bivalve mollusca, fragments of spiny lobsters and much coral.

Among the snail shells was one spiral variety of small diameter. It was quite numerous in these deposits and the specimens were well preserved, many of them quite perfect. Later on, after settling down to work in the interior, I found this same species of snail alive, and quite common as a land species! Could it be that here we have a marine species that has survived an uplift, and because of the tremendous rainfall and almost continuous moisture upon the ground, has survived and adapted itself to a true terrestrial existence?

At night the forests are a strange medley of sounds which issue to some extent from tree frogs, but chiefly from the insect army. One fellow that I sought for weeks, called the "Black-smith" by the natives, possessed the most wonderful powers of ventriloquism. His notes were pure and musical, like the fall of a hammer upon a silver anvil. At length I found him, a big brown tree cricket producing these



#### EATING A DINNER LARGER THAN HIMSELF

*A veritable monster of the insect world: a Hercules beetle eating a banana. In life, it is about twice this size and is a flying beetle, its wings making a sound, in flight, like a distant airplane*

clear tones by means of a sort of file and sounding board situated upon his tough wings.

To my oil lamp at evening came the huge, blundering Hercules, great beetles whose wings in flight produce a tone similar to that of a distant airplane. They fought fierce battles with their powerful, lobster-like projections and ate bananas so completely that I could find no leavings. True to the spirit of their island of anomalies, the females possessed no unusual features at all, and reversed the usual sexual procedure by hunting out the males for themselves.

**T**HERE are mantids or "animated stick" insects which lay masses of beautiful pink eggs, resting upon their elbows while so doing, while among the insects which are partially luminous at night there is one, a big beetle—I hardly dare tell it—that possesses two perfect oval headlights and a tail light in addition. When they crawl upon the ground the illusion of tiny automobiles scurrying about is quite perfect.

Another strange insect is a butterfly with orange colored wings. The female possesses scent glands with the odor of banana oil. These have been given to the insect for the special purpose of attracting the males, and if one of these butterflies is captured and squeezed very gently she will thrust out her precious glands, filling the air with her strange perfume. Soon afterwards a male will appear from the forest or trail, then another and another, until there are a number of rivals competing for the lady.

Even the fishes that live in the mountain streams of this island I found to be queer fellows. They have no choice in the matter, for conditions are so strange that they have become strange creatures also. In many cases these streams

are only rain carriers, which roar and tumble today but tomorrow may be all but dry if no rain happens to fall. Fishes are able to exist in such places by means of special adaptations which have evolved with their environments.

The spotted goby is a remarkable example of one of these fishes. It lives in streams which often become quite dry in the sense that water does not actually flow, although the sand and stones of the stream bed may remain damp. When the stream stops flowing, the goby goes into the damp sand and breathes atmospheric air. A specimen kept in a tiny aquarium without any vegetation to oxygenate the water, lived successfully for a long time, sticking its nose out of water when it required air.

Another condition which this goby must meet is that of too much and too violent water, as is the case in these streams directly after a deluge in the mountains above them. At such times the force of the water would sweep the fishes down into the sea, but another remarkable adaptation takes care of this in the form of a powerful suction disk, situated under the fish, and which it may use to fasten itself securely to a stone beneath the raging water until the danger passes.

**I** THINK perhaps the strangest of Dominica's wild children is a tiny species of forest frog. The frog itself is not so extraordinary, but in its life history, which it became my privilege to unravel, we have the most remarkable case of adaptation that I have ever seen.

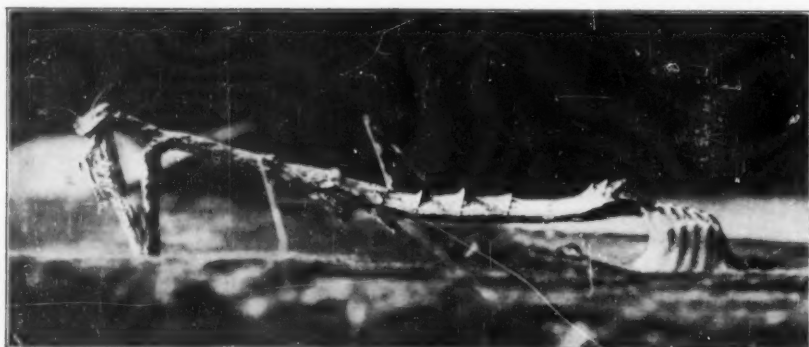
Most young frogs are tadpoles and require a pool of some sort in which to swim and grow to the perfect state, but this little creature of the tropical islands emerges directly from its egg into the world as a perfect, but very minute frog. The tadpole stage may be traced within the unusually large eggs which have been developed by nature to supply sufficient food substance for the entire metamorphosis.



#### IT LIVES IN HOUSES

*This terrifying creature is the harmless gecko, a lizard that lives on insects in Dominican houses*





## AN ANIMATED STICK

A Dominican mantid laying a mass of its peculiar pink eggs, resting on its "elbows" during the process. Note the malevolent glare it bestows upon the camera while the picture is being taken

The eggs are deposited upon the damp forest floor and here they lie until the young frogs emerge.

In this particular island, although blessed with a tremendous rainfall, there is really no place where tadpoles could live successfully. There are almost no forest pools because the land is so steep. The rivers are too swift and the streams contain too little food, and so with water on every side the species has found it necessary to evolve into one that eliminates the aquatic stage altogether.

AMONG the higher forms of life that inhabit Dominica, are some very strange and interesting things. Reptiles are very common although limited in species, and the smaller brown and green anolis lizards live in the houses as much as they do outside. They have learned that the lamps which man burns during the evening act as splendid lures for their insect prey. Lizards that come into the houses are assured of food at all times.

The newcomer to Dominica might easily be upset by the truly frightful geckos which prowl about the walls at night. They are often pale and ghostly in color and their great eyes add to the horror of their looks. They are harmless and friendly creatures that have also come into our headquarters to

collect their share of insects that are attracted by our lights.

If a gecko is attacked he instantly and purposely snaps off his tail with a sudden violent motion. The creature now crawls off slowly and cautiously while the tail, due to muscular reactions, thrashes violently about, attracting far more attention than the real main body of the lizard. Thus the geckoes are enabled to escape their enemies in a remarkable manner.

It is a strange and interesting fact that no poisonous species of reptiles occur in Dominica, although the island of Martinique, which is near enough to be seen on clear days, supports numbers of the deadly *fer-de-lance*. Isolation has of course accounted for many strange developments that have taken place and also for the limited life which the explorer finds there, yet it is hard to understand why this snake has not reached Dominica.

NOT many species of birds inhabit the island, but individuals are numerous and the mountain forests are filled with song. Despite the fact that only about 55 species have ever been recorded, it boasts the imperial parrot, one of the largest of the family and a bird which has never been found anywhere else in the world. Here we have an island approximately 30 miles long and 15 miles wide, a mere speck in the world, upon which a unique bird holds forth. They are always difficult to obtain, as they nest in holes in tall trees that are all but impossible to climb. They are well protected by the government of the Leewards, which is a very fortunate thing. However, a single specimen was brought back for the New York Zoological Gardens by the author.

How this parrot came to evolve in Dominica, if it actually did, is a mystery that will never be certainly cleared up. In the opinion of the author it is a mutation from a mainland species that possibly inhabited the island at some former time. The older form died out, leaving the imperial species which is found today.

Bats are the dominant mammals of the island. Like the birds they reached the islands easily enough from the mainland with their powerful wings, but after arriving, because of peculiar living conditions, they developed curious adaptations.

IN one of the foul crevices explored by the author high in the mountains, tiny bats were found in great numbers, living in a dark hole in the earth that belched out a warm foul breath that a man could bear only a short time. Descents were made into this damp and fetid hole to collect and study the animals which were living in it without any apparent harm to themselves.

The gases of this fissure caused dizziness and a swollen feeling of our heads, and wherever in the semi-darkness we dropped rocks, a long and significant interval would elapse before the dull thud in the depths would inform us that bottom had been reached.

Dissection of these bats showed glands connected with the nostrils, which undoubtedly have something to do with their ability to inhabit their strange and unhealthy homes.



## BELLY OF THE GOBY

The suction disk with which this peculiar fish clings to rocks during flood periods

Many other varieties of bats wing over and through the great forests of Anomaly Island. Some are small and delicate, others huge, red-furred, winged creatures with a wing spread of two feet or over, with rasping tongues and strange fleshy nasal appendages for purposes still unknown.

Some scientists have scorned the smaller islands as places for study, because of their proximity to the far richer mainland of South America, yet where there is life as interesting and as remarkable as that which I have begun to investigate in Dominica, why go farther afield for the sake of mere numbers? These islands shall be my playground and laboratory for a while yet, for who can say what the future will reveal from the still unexplored wilderness of the interior?



## FROG'S EGG

Greatly enlarged to show the tiny frog within. He issues forth perfectly developed



#### A FLEET SUBMARINE

*The V-2, one of our new "V" type submarines, which are capable of long periods of battle operations with the fleet at sea*

HAVING examined the conditions that exist in regard to bases, essential types of ships, and the fleets of men-of-war that are possessed by the principal naval powers, with particular reference to the present relative position of this country, the question naturally arises as to what might best be done to remedy the defects that already exist and to strengthen our navy to a position where it would become a reliable instrument of national defense.

TO do this it is necessary to discuss in some detail what has already been done by this and other countries following the Washington Conference, and particularly to discuss what was proposed at the Geneva Conference in the summer of 1927, and, following the failure to come to an agreement there, what has further been proposed in this and other countries. This leads naturally into a consideration of the recommendations—which have since come to be known as the Navy Building Program—submitted to Congress by the Navy Department when the 70th Congress convened in December 1927. From a reference to the chart of "Fighting Ships Built, Laid Down, or Authorized Since the Washington Conference," it is at once apparent that there has been a great deal of difference between the new construction programs of Great Britain and Japan, compared with ours.

The two new plane carriers, our principal construction during the period, were really ships that had already been laid down, whose conversion to plane carriers was expressly provided for in the Washington Treaties. In the nearly seven years that have now elapsed since the Washington Conference, six fleet submarines and eight cruisers constitute really our sole additions during

## *Balancing Our Fleet as Suggested by the Navy Building Program, Together With an Agreement for Further Limitations, Will Insure Against War*

By CAPTAIN N. H. GOSS, U. S. N.

that period. Furthermore, the cruisers were not authorized until after both Japan and Great Britain had actually laid down very comprehensive programs of additional cruisers.

It should be remembered that the Washington Treaties left full latitude in building of naval craft beyond the two types that were expressly limited—that is capital ships and plane carriers; and decided that, in building other types, each power was within its rights to pursue a policy of strengthening what it might regard as its own interests.

REFERRING again to the diagram, we see that Japan has laid down and authorized a program embracing all the principal types permitted, and has, from her point of view, very properly decided to use the money, saved by the cancellation of her paper program of eight capital ships, to construct large numbers of the cruisers, submarines, and torpedo craft that she considered desirable to balance and strengthen her standardized capital ship strength. She now has what is undoubtedly the strongest submarine force afloat, composed as it is almost exclusively of modern vessels, adequate in size to operate far beyond the natural defensive limits of her home area. She has also a formidable, modern destroyer force and, considering her interior lines, a very strong cruiser force—all largely built since the Washington Conference.

Despite the general British preponderance in auxiliary types, they too have laid down or authorized an exten-

sive program since the Washington Conference, particularly, it must be noted, of light cruisers. Despite their overwhelming strength in this type, they have laid down and authorized no less than twenty-four additional vessels of well over 200,000 tons. They have also materially modernized their submarine force by an addition of twenty-five new vessels.

IN the meantime, we have not seriously attempted to replace our obsolete tonnage in either cruisers or submarines. In connection with such replacements, it is to be noted that the Washington Treaties did fix an age limit on capital ships, limiting the time before which they may be replaced. Fixing the age of that type at twenty years seems a wise and logical thing, since it makes possible the gradual replacement of vessels that have grown obsolescent or worn out, by later classes within the prescribed total tonnage limits, that is by vessels that are modern and embody later improvements and ideas. It is only natural, too, that there should be a disposition to apply this same system to other types, particularly since the smaller and more complicated vessels such as submarines and destroyers wear out or otherwise deteriorate very quickly. The total tonnage idea seems the logical one, rather than the limitation of numbers, since it permits different powers to adapt the size of their units to their own needs and base resources.

Following this precedent established for capital ships, an age limit of twenty

years for cruisers, sixteen years for destroyers, and thirteen years for submarines, based on experience as to about when such vessels need to be replaced, seems a reasonable one.

So, we find that, in 1927, the United States, actuated by a desire to forestall or remove competition by fixing a limit to the remaining principal types of war craft, invited the other powers to another conference for the limitation of naval armament which met at Geneva. Limiting these other types seems particularly desirable, for, unless they are limited, naval competition may still take place, and it is a matter of history that the spirit of rivalry and distrust engendered by such competition may be one of the principal causes of war. A recent example of this may be seen in the rivalry that existed between Germany and Great Britain previous to the World War. Since each side was unwilling to compromise or to agree upon a limitation of dreadnaughts, successive increases in German naval strength brought about corresponding increases by the British with resulting strained relations that, undoubtedly, constituted one of the contributing causes of the war.

IN the belief that an agreement limiting all principal types would remove this competition and tend to lessen the causes of war, the United States accordingly sought at the Geneva Conference to extend actual limitation to cover these other types. It was only natural that we should seek to extend the principle of the 5-5-3 ratio which already applied to capital ships and plane carriers. If this were done, and sufficient tonnage were allowed in each type to permit naval powers to balance their fleets with sufficient numbers of ships to meet their own needs—with sufficient strength for requisite duties with the battle fleet, for commerce protection, and for communication duties—a condition could be achieved where each of these powers might have a fleet adequate to its legitimate needs and able to command respect for its national policies, a fleet sufficiently strong to constitute an effective fighting organization, yet definitely limited by treaty so that there would be none of the competition that has contributed to war in the past. Such an agreement including a prescribed age limit for individual vessels would permit each power to modernize its fleet by scrapping its older vessels and keep its fleet up to date by replac-

ing the older classes as they become obsolete.

At the time of the Geneva Conference, it seemed that the other powers might readily agree to such a proposal since they had already balanced their fleets by new construction following the Washington Conference, and since the British in particular had increased their capital ship strength by building the two new battle-ships permitted by the Washington Treaties. These two new ships which the British now have

These proposals, in effect, would not only have left them a cruiser strength far in excess of ours, since the cruiser tonnage we possess, with the exception of the ten modern "Omahas," consists of vessels that are entirely obsolete, and useless in comparison with their modern cruisers, but would also have limited us to a comparatively small number—not above twelve—of the 10,000 ton class which, as previously shown, is the size best suited to our needs. Actually, the effect of this proposal would have been more far-reaching still, because, since only this large class could mount eight-inch guns, all other cruisers would, not only automatically but specifically as well, be limited to guns no larger than six inch, which guns could also be mounted on most vessels of the vastly predominant British merchant marine.

THE British also proposed an age limit of eighteen years for the larger and sixteen for the smaller cruisers rather than the twenty already established for capital ships. There are reasons both for and against this proposal. It would permit keeping cruiser strength more up to date, more homogeneous, and would permit the British particularly soon to replace their cruisers built during the war. It would in the long run, however, add considerably to the expense of cruiser replacements.

The British proposed later on at the Geneva Conference to make 6000 tons the upper limit of future cruisers, while at the same time exempting the cruiser strength already built. This would, of course, have left them not only a

predominant cruiser strength but, since 6000 tons is quite too small to be useful to us, also have augmented very greatly their relative naval strength due to the increased strength it would give to their merchant marine.

The Washington Treaties not only fixed the capital ship limits, but specifically provided the earliest date when existing capital ships may be replaced. They fixed 1936 as the time before which no changes in existing capital ship agreements should be made, and further provided that this country should call a conference at Washington in 1931 to discuss further extension of the treaties beyond 1936 and any other matter on the general subject of naval limitation that might arise in the meantime.

Notwithstanding this, however, the British included in their proposal at

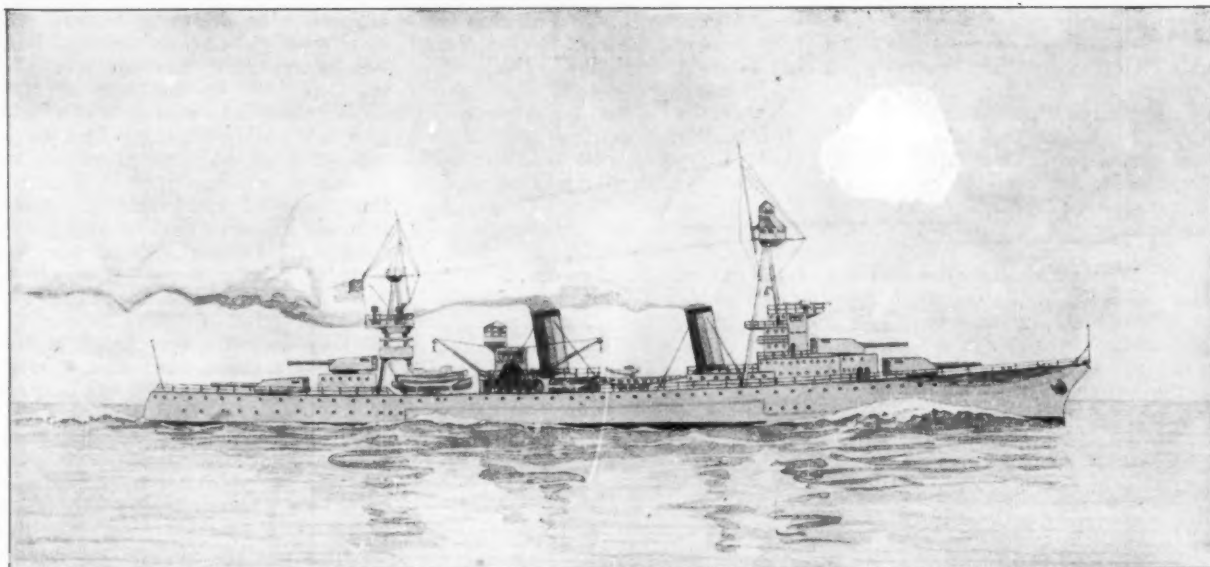
### Fighting Ships Built, Laid Down or Authorized since the Washington Conference

GREAT BRITAIN	UNITED STATES CAPITAL SHIPS	JAPAN
 2 Ships - 70000 Tons	NONE	NONE
 2 Ships - 37800 Tons	AIRCRAFT CARRIERS  2 Ships - 44000 Tons	 2 Ships - 25800 Tons
 24 Ships - 222740 Tons	LIGHT CRUISERS  8 Ships - 80000 Tons	 16 Ships - 128250 Tons
 18 Ships - 1300 Tons	DESTROYER LEADERS NONE	 24 Ships - 40800 Tons
 30 Ships - 15700 Tons	DESTROYERS NONE	 27 Ships - 34840 Tons
 55 Ships - 22145 Tons	SUBMARINES (ALL CLASSES)  6 Ships - 15000 Tons	 55 Ships - 44954 Tons

are the last word in design—are, in fact, the only capital ships designed since the war—are of the largest size permitted, larger than the battle-ships any other navy possesses, and carry more guns of the heaviest caliber allowed than are mounted on any other capital ships.

The British at this conference at Geneva seemed unwilling to apply the equality principle embodied in the 5-5-3 ratio to other types of vessels, particularly cruisers. They countered with a proposition that would, first of all, rigidly limit the number of cruisers of the 10,000 ton class, carrying eight-inch guns; secondly, establish a new size limit of individual vessels of considerably less tonnage; and finally, exempt from this limited total the very large force of modern cruisers which they already possessed.





#### CRUISER OF THE NEW "PENSACOLA" TYPE

An artist's conception of the new class of 10,000-ton cruisers, a number of which are being built by the United States. The Navy Building Program outlines the need for more of this type instead of cruisers of the 6000-ton class proposed by the British at the Geneva Conference in 1927

Geneva a proposition to extend the age limit of capital ships to twenty-six years, to reduce their size limit to 30,000 tons, and reduce the size of turret guns in future capital ships to not above 13.5 inches. This proposal, if adopted, would materially diminish our naval strength. As has been shown, we are at present handicapped by lack of battle cruisers.

The treaty now provides that we may lay down two new capital ships in 1931 and two more in 1932. Presumably we would desire these to be of the battle-cruiser type in order to overcome our existing deficiencies in

that direction and some of the handicap we now suffer through lack of bases. Were the size limit reduced to 30,000 tons we would be unable to build any battle cruisers, since such size is too small to give these vessels both the high speed and the amount of protection that modern defense requires. It is easy to note also that such an extension in age limits would automatically extend the present advantage of the Japanese and the British—particularly the latter since they have the *Hood*, 12,000 tons greater than the new limit they proposed, and their two new 35,000 ton battle-ships as well.

The British advanced economy as one reason for this new capital ship proposal. Our proposal, however, for limiting the aggregate of cruiser tonnage would also effect very material economies, since the powers possessing base resources would be able to build the smaller and cheaper cruisers adapted to their needs, and do this gradually; and since competition would be eliminated there would be no necessity for feverish construction. It would not be wise to forget that any reductions in the strength of our capital ships would automatically increase the naval strength of the countries possessing large merchant marines and numerous bases, and would diminish correspondingly even our potential naval strength.



#### OUTWARD BOUND FOR ANNUAL MANEUVERS

The United States fleet leaving San Francisco for annual maneuvers in the Pacific. These yearly trials quickly show the lack of balance of our fleet and the need for more ships of essential types

**T**HIS British desire to re-open the capital ship question was reiterated last spring at the short session of the preliminary conference, under the auspices of the League of Nations, looking to a limitation of naval armament. At that time the British again proposed extending the life of capital ships to twenty-six years, to reduce the size of their turret guns to 13.5 inches, and to reduce the size of future capital ships to something under 30,000 tons.

In connection with the British cruiser proposals, it is well to remember that since the Washington Conference, they and the Japanese have deemed it desirable to build the largest class of cruisers permissible, and particularly to remember that they authorized and actually laid down numerous vessels of this class before any were even authorized by us.

Divergence of opinion on the cruiser question was so wide at Geneva that no great amount of consideration was

given to destroyers and submarines, the latter partly because the French and Italians were not represented, hence any agreement materially affecting submarine strength could hardly be made without the concurrence of these powers, and since, rather logically, the British considered destroyer strength inherently involved with submarine strength, the destroyer being the latter's principal antidote. The British have consistently favored the total abolition of the submarine, because it is such a menace to them and, particularly since, in modern war, most vessels of the merchant ship type proceed as convoys operated by the federal government. Therefore they have largely the status of men-of-war.

SO we see that, at Geneva, the British were really not willing to discuss further limitation on a basis of equality. They proposed not only to keep the preponderant cruiser strength they already had, but also to limit rigidly to a small number the large class of cruisers that our base limitations require for us. It accordingly seems reasonable to believe that our proposals were better adapted to the preservation of peace, since we proposed nothing beyond the 5-5-3 ratio in actual vessels without any allowance for the inherently superior positions of other powers with regard to bases.

It seems that our basic idea was sound because we proposed merely to extend a system that would allow each nation a total navy adequate to its needs, and would leave each free to build the classes most suitable for itself, while at the same time removing competition and providing a condition of balanced strength by means of a tonnage limit on types. This would also, as before noted, permit the gradual replacement of the older classes of each type as they reach reasonable age limits.

In the previous discussion we have seen what deficiencies exist in our fleet compared with the other navies. We have also considered what this country desired to accomplish at the Geneva Conference. We will now consider what the navy has proposed to balance our fleet by supplying some of the existing deficiencies in essential types.

The public attention focused on the naval situation by the failure of the Geneva Conference gave the navy the opportunity it had long needed to interest the country in the needs of our fleet. These needs had existed increas-

ingly ever since the Washington Conference as our fleet fell farther behind in relative strength due to the building program of other powers. The country, however, had been too engrossed in other matters to consider seriously the needs of naval defense until our fleet's weaknesses were glaringly exposed at Geneva.

The need to balance our fleet by remedying deficiencies in auxiliary types has existed, of course, ever since the Washington Conference standard-

cruisers, nine destroyer leaders, and thirty-one submarines seemed large but, by consulting the diagram of fighting ships built by the three principal powers since the conference, it is to be seen that while others have been carrying out large building programs, we have been building very little during this time. It is estimated that not less than eight years would be required to complete this program. If now we consider this as spread over fifteen years that must elapse since the Washington Conference until it could be completed, it will be seen that the average number per year will be quite small, or less than five vessels, in fact, including even the smaller types.

TO analyze the program in some detail; the five aircraft carriers are desired to complete the tonnage prescribed by the Washington Treaties for us; the destroyer leaders are desired to provide a type we now lack entirely. These are not desired to increase our total destroyer tonnage, since we have expressed our willingness to scrap down to an agreeable limit. The submarines are replacements entirely. They would give us a modernized submarine force of something under 90,000 tons—about 84,000—to replace the somewhat over 90,000 tons we now have. The light cruisers requested are not only needed to supply the deficiencies that have already been pointed out, but most of them, or 179,425 tons, are designed to replace present obsolete cruiser tonnage.

By examining the diagram of how the fleets would compare if our program were added, it will be seen that our program would in no way exceed the principle of the 5-5-3 ratio. It would not exceed the British cruiser strength; it would not equal the ratio of modern submarines already built or building by Japan; it would, naturally, not exceed the limits of plane carriers already prescribed by treaty. The only type in which we have an actual excess in tonnage is destroyers, and we have repeatedly offered to scrap all excess in these whenever the other countries will agree to a limitation of other types.

When we remember that war experience has shown that not more than one third of a submarine force could be kept at sea, even with the short distances that obtained in the European submarine zone, it can readily be seen that our projected submarine force of

### Comparative Strength including vessels proposed by Navy Building Program



ized capital ships, and our navy has been relatively weakened, naturally, by the large programs of these types built by the British and Japanese since that conference. When Congress convened in December, 1927, the Navy Department submitted for the first time a program devised by the navy itself as the responsible technical advisor. This has since become generally known as the Navy Building Program. It represented responsible naval opinion of what was needed to correct existing deficiencies in essential types and give us a fleet reasonably adequate to our needs. Since it was based on the 5-5-3 ratio principle of actual vessels, it did not presume to overcome our existing base deficiencies.

To some, this recommendation for five aircraft carriers, twenty-five light

fifty-two modern vessels could hardly be called excessive. From this we see that the navy's desire to eliminate existing deficiencies by building, within the limits of the 5-5-3 ratio, types that other nations already have, is not, in fact, a desire to start a naval competition.

The navy's program, it will be noted, would give us about the 400,000 tons of cruiser strength and the 90,000 tons of submarine strength needed to balance our authorized capital ship strength, and we have stated our willingness to scrap destroyers in excess of 250,000 tons.

**T**HE navy has no quarrel with the British for advocating at Geneva what they consider their own interests, but desires only to point out that some agreement is necessary in order to avoid competition and unfriendliness. As previously stated, the limits should be sufficiently large to provide a force adequate for the individual needs of each country, but a cruiser force actually exceeding 650,000 tons, desired by the British, seems too large for reasonable needs and a source of too great expense. We, lacking the British base facilities but with just as important trade and commercial interests abroad and with our insular possessions at such great distances, feel, however, that about 400,000 tons of cruiser strength is more reasonably adequate.

The British have been more inclined to talk in terms of numbers than we. Their Admiralty experts, including

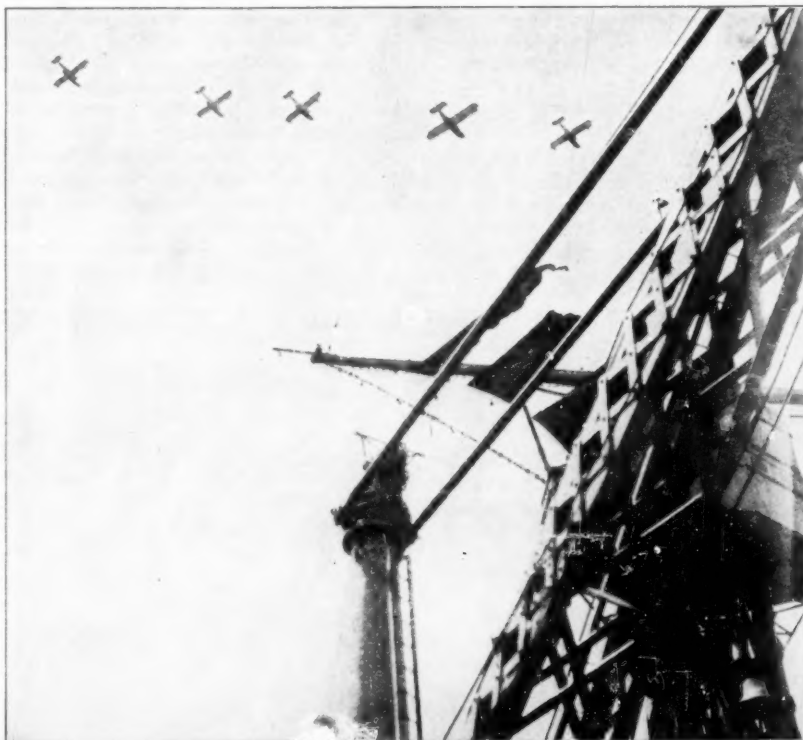


#### EFFECTIVE CONCEALMENT

*A destroyer division at sea laying down a smoke screen. The "eyes of the navy," observation planes, are used to spy on enemy ships and spot gun-fire behind this rolling pall of black smoke*

Lord Jellicoe, have stated their actual needs to be about sixty-three cruisers. Our responsible naval opinion has fixed our cruiser needs at about forty-three. If now we compare the tonnage of these

sixty-three cruisers with the forty-three desired for us we find that they actually amount to about the same in each case—around 400,000 tons. It seems therefore, that a basis of agreement may actually be already in sight. Such an agreement would be an example of how much better it is to base an agreement upon actual needs rather than an arbitrary figure.



#### AN OBSERVATION SQUADRON PASSES

*A squadron of planes passes over the fleet. The two airplane carriers, our principal construction since the Washington Conference, carry many planes and allow extensive observation flights at sea*

**A** SOLID basis for peace is a force adequate to needs, yet limited. Unless it is limited, sooner or later competition will arise with the dissension, suspicion, and distrust that are contributing causes to war.

It has been said that a fleet is an instrument of policy, but it will not be an effective one unless adequate. Without an adequate fleet there is no way to check the aggression of others. With it we could pursue our non-aggressive way without interference.

Proposed congressional action on the Navy Building Program includes present authorization for only a part of the program, namely, fifteen cruisers and one plane carrier. While a material step towards bettering our present condition, this will not remove the other deficiencies that exist or give us a navy adequate to our needs. Lack of adequate preparation for defense cost us twenty billion dollars in the last war.

Modernizing and balancing our fleet along the lines suggested by the Navy Building Program, coupled with an agreement on limitation of all essential types, is the surest way to prevent another war.



# The Month In Medical Science

## *A Review and Commentary on Progress in the Medical and Surgical Fields*

By MORRIS FISHBEIN, M. D.

Editor of the Journal of the American Medical Association and of Hygeia

### Executive Health in Industry

IN 1919, the president of the Dennison Manufacturing Company decided to institute health supervision for the executives of that group. He realized that practically everything in a factory is inspected and examined regularly to prevent waste and to maintain the equipment of the plant in the highest possible state of efficiency. The key men of any industry are responsible for its progress or failure, and the executives are the key men.

The president of the corporation called in his personal physician, whom he authorized to adopt the plan. The physician visited many other industries throughout the country, studying various types of health supervision. He finally worked out a plan which involved yearly examination of 50 of the major executives of the company. These examinations were not compulsory, but after the matter was explained to them by the president, all of the executives decided to take advantage of the opportunity.

In 1921, eighty minor executives, including department heads, chief clerks and foremen were given opportunity for examination. Dr. Halstead G. Murray has recently told of the results of the work thus far. Among the 80 minor executives, 28 major defects were found in the first examination, including disturbances of the heart, varicose veins, skin diseases, hemorrhoids, and ruptures. Minor defects included overweight and underweight, bad vision, defective hearing, decayed teeth, infected tonsils, high blood pressure, low blood pressure, and flat feet. At the time of the examination record is made of the health habits of each individual and he is informed as to correct personal hygiene. Such surveys indicated many opportunities for correction.

It was soon found that the examination gave opportunity for the application of several modern ideas in preventive medicine. Hence inoculation against communicable diseases, three weeks' vacation annually with salary, special half-holidays in the summer in addition to the Saturday half-holidays, and special vacations for men who required them because of overwork, became a part

of the plan to keep executives in the best physical condition.

The executives now like the health examination, co-operate fully, follow the advice given to them, and willingly correct minor and major physical defects when these are called to their attention. The directors of the corporation feel that health supervision has shown worth-while results, sufficient to justify its continuance.

### Imitation Cod-Liver Oil

SINCE the information has become available that cod-liver oil is the richest substance known in two of the important vitamins, namely, vitamins A and D, the latter being specific against rickets, all sorts of imitations of cod-liver oil are offered to the public with specious but unwarranted claims. Because of the lack of palatability of cod-liver oil, many attempts have been made to develop concentrates or tablets which would contain the important factors. Thus far the only tablet which has met the approval of the Council on Pharmacy and Chemistry of the American Medical Association is one known as Oscodal. Because of the difficulty of preparation the price of this product is somewhat high.

In the city of Salford, England, a large chain drug store offered for sale McCoy's cod-liver oil extract tablets. The city prosecuted the store for selling these tablets, since chemical and biologic tests showed that they did

not contain vitamin A or D. As a substitute for cod-liver oil they were therefore worthless. Investigation revealed that the tablets were made from essences manufactured in America, and that there were no official tests as to the vitamin efficiency of such products. As a result of this trial the British concern was fined 150 dollars and paid 375 dollars in costs.

It is important that anyone who takes cod-liver oil or who gives it to an infant should have a potent preparation. Nothing is so disastrous as to expect to prevent a disease, such as rickets, and with perfect confidence to give remedies supposed to be of merit, and then to find that failure has resulted because of inefficiencies of the products used.

### Occupational Treatment of Disease

WHEN a person has recovered from a long illness, he is likely to be disturbed at life in general. He may hesitate to go back to work due to his inability to carry the burden, or it may be that the work with which he was formerly associated is no longer suitable to his physical condition, and that some new occupation must be found for him. The problems of occupation associated with the treatment of disease are included under the general heading "occupational therapy," for which organizations now exist in the United States.

These problems constitute a definite specialty in medical practice. Occu-



OCCUPATIONAL THERAPY SHOP IN A LARGE HOSPITAL



RESTORING USE OF LIMBS

The patient shown suffered with a broken back and paralysis. Daily work with the jig saw helps in the restoration of the bodily functions



IN BED BUT AT WORK

Bedside occupations add to the general morale of the patients and help to make many months of irksome confinement pass much more rapidly

pation in the treatment of disease has been divided by Harry E. Mock into three types: diversional, which is addressed primarily to the patient's mind; purposeful or curative, which is practiced not only to occupy the mind, but with the direct purpose of restoring proper function in certain nerves and muscles, and pre-vocational, which is work undertaken to teach the patient definite training for some trade or industry, thus helping him to provide better for himself after recovery.

Among various forms of occupational therapy commonly used in hospitals are the making of basketry, or reed and wooden furniture, mechanical training and carpentry. In cases in which the joints have become stiffened, the operation of a velocipede jig saw is useful; for ankle joint exercise, the foot pedal scroll saw and foot power sewing machines are helpful; for stiffened fingers and wrists clay modeling and the making of papier-mâché forms are advised.

The occupational therapist builds the handles of the saw, hammer and plane with wax in order to fit the deformity of the fingers that may be present. In cases in which the shoulder, elbow, or upper part of the back need exercise, basket and loom weaving are applicable. While the patient is doing these things he not only improves his physical condition but derives pleasure from the manufacture of artistic objects and perhaps forgets the pain which the exercise may cause him.

#### Skin Irritations in Gasoline Stations

**M**EN who handle great quantities of oil and gasoline not infrequently develop irritations and infections of the skin. Today thousands of men earn their livelihoods by working in industries involving such handling. Two types of inflammations of the skin are most frequent. One is the

irritation due to the action of the gasoline, benzene, and similar substances. Since these substances dissolve the fat, they take the fat out of the skin on the back of the hands and on the forearms, and set up inflammatory reactions.

As a result of repeated actions of this sort the skin becomes thickened, furrowed, and tends to peel off. Protection of the skin for even a brief period and the application of suitable dressings with oil or fat in them brings about prompt recovery.

It has been noted for some time that lubricating oils set up inflammations of the skin, permitting easy access of bacteria, with the production of boils and pustules. The lubricating oils serve to seal dirt and grime in the openings of the skin and thus to give the bacteria opportunity to grow and produce infectious matter. Here again the treatment depends on thorough cleanliness, removal of the contact with the irritating substances, and proper opportunity for the human body to take care of infections.

#### Americans Drink Less Tea

**A** RECENT report of the United States Department of Agriculture indicates that nearly six and a half million pounds less tea was imported during the year ending June, 1928, than during the previous year. This represents a decrease of 7 percent. At the same time there has been a considerable increase in the use of caffeinated drinks. The chief ingredient of tea from a chemical point of view is caffeine. This is a stimulating substance. Many persons have argued that it is inadvisable to stimulate the human mind and body repeatedly with caffeine, and as a result there has been a decrease in the consumption of tea and coffee and an increase in the use of decaffeinated coffee and of coffee substitutes.

It is an interesting point, however,

that all sorts of soft drinks which contain caffeine are increasing in soda fountain consumption. The public has no knowledge, of course, that these drinks have caffeine added to them and that the caffeine content is largely responsible for the stimulation felt.

#### Genius Transmitted Through the Mother

**I**N the *Deutsche Medizinische Wochenschrift*, Sanitätsrat Leven applied recent knowledge of eugenics and heredity to prove the point emphasized by many philosophers that genius and intelligence are inherited through the mother rather than the father. Schopenhauer cites as examples the fact that Alexander the Great and Caesar Borgia inherited their character and heart qualities from their fathers, and that Hume, Kant, Schiller, Goethe, and Walter Scott inherited their intelligence and intellectuality from their mothers.

It has been established by modern eugenic studies that sex differentiation is associated with definite chromosomes in the germ cell. The chromosome that carries the sexual character of the female has two definite components known as the x-chromosome and the y-chromosome. In most living organisms the y-chromosomes are inactive. In man, the male receives his x-chromosome from the mother, but the female receives her two x-chromosomes from the father and mother. As pointed out by Leven, psychic endowments are associated with the sexual chromosome. The male can inherit this chromosome only from the mother. He does not transmit it to his sons, but he does transmit it to his daughters.

It is, of course, reasonable that other factors may have to do with intellectuality. On the other hand, Leven urges that exclusive hereditary transmission of the x-chromosome to the male establishes a natural connection between genius and the female sex.





over-run the inner wheel comes into play to some extent when a railroad locomotive is running on a curved track. It has been already noted, (See first installment in November issue. Editor.) that locomotive tires are coned. In rounding a curve, the outer wheel tends to run on the larger diameter and the inner wheel on the smaller diameter of the tire. The slope of the tire face gives about one quarter of an inch difference in the diameters. This, on the usual gage with three-foot wheels, would carry the locomotive round a curve with a 225 yard radius.

The over-running effect obtained by coned tires tends, in itself, to keep the wheels on the track without the flange coming into action at all. This is illustrated in Figure 14, and applies to a pony truck with a single pair of wheels when the pivot pin connecting it to the engine frame is not in front of the axle.

LET the axle with its attached wheels be running upwards; the motion will carry the wheels so that  $B$  runs on its larger diameter and  $A$  on its smaller diameter as shown at  $CD$ . The end  $D$  is now carried ahead of the end  $C$  owing to the greater distance traveled in each revolution by the wheel at  $D$ . From the position  $CD$  the axle will run to the position  $EF$ . The conditions are now the same as at the start, with the exception that presently the axle will be running on its larger diameter at  $E$  and its smaller

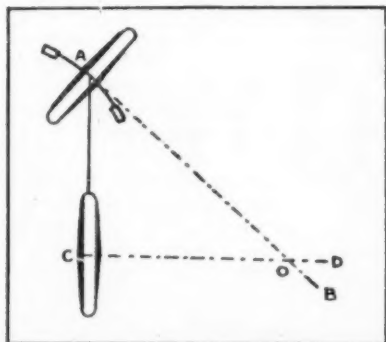


FIGURE 15

In bicycle steering, the machine turns about the intersection of the axles,  $AB$  and  $CD$  at  $O$

diameter at  $F$  which will again run it back to the straight. Thus the axle pursues a sinuous path in its progress along the rails. A model to illustrate this action may be made by taking two corks and passing a knitting needle through them to form an axle. The assembly may be run down sloping tracks formed of two pieces of taut thread as illustrated in Figure 14.

THE principle of bicycle steering is shown in Figure 15. The front wheel can, without sideslip, run in a circle about any point on the line  $AB$  which is the axis of the steering wheel.



FIGURE 16

The bicycle steering wheel trails behind the trace of the steering column as shown by rod

The rear wheel can, without sideslip, run in a circle having a center anywhere on the axis  $CD$ . There is one point common to both  $AB$  and  $CD$ , so that this gives a unique center point about which the machine may turn without sideslip of either wheel; and this is therefore the point about which the bicycle turns. The track of the rear wheel is the circle center  $O$  and radius  $OC$ , while the track of the front wheel is the circle center  $O$  and radius  $OA$ . Since  $OA$  is greater than  $OC$ , if the front wheel clears an obstacle, the rear wheel will also clear it. This is an advantage of front steering which does not obtain with rear steerers. With rear wheel steering and a car alongside a curb, getting away forward involves turning the steering wheels so as to run them up on the curb, a procedure contrary to economical tire use and comfortable riding.

The fact that  $OC$  is less than  $OA$  explains why a bicycle or automobile can be maneuvered into a restricted area



FIGURE 17

The steering column of the "scooter" strikes ground behind wheel, gives negative castor

with greater ease when in reverse. To drive in between a pair of narrow gate piers off a narrow roadway may be impossible to do directly, but possible if the car be driven past and then reversed in. This is also the best mode of turning a car around on a narrow road.

IN the bicycle, the steering column is given a rake so that its axis strikes the ground a few inches ahead of the point of wheel contact. This is shown in Figure 16. In running, the wheel trails after the point on the ground indicated by the rod, so that obstructions encountered do not swerve the steering to right or left. This construction is equivalent to the castor arrangement of wheels on furniture. There is a difference, however, in that the furniture castor, with its vertical pivot, does not

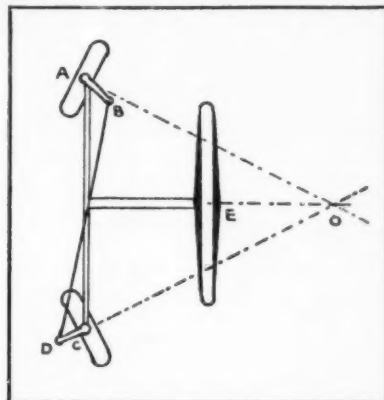


FIGURE 18

To steer a tricycle, all axles, prolonged, must intersect at some point, as is shown

alter the height of the center of gravity of the article as it turns, whereas turning the bicycle wheel lowers the center of gravity of the machine. This, in the bicycle, would tend to make the straight running position unstable were it not more than counter-acted by the action of the road resistance at normal speed on the castor setting of the wheel.

IT is worth noting that in the "scooter," Figure 17, there is what may be termed a negative castor effect—the steering column strikes the ground to the rear of the point of wheel contact. Following from this setting is the fact that turning the steering wheel of the "scooter" raises the center of gravity of the machine, so that the weight on the footboard tends to keep the steering wheel set on a straight course. This will be the predominating effect here, as, on a smooth road at the usual speeds, the action of road resistance on the negative castor in tending to swerve the steering will be less than the action of the weight in tending to keep it straight and thereby the "scooter" is made stable.

The steering of three-wheeled ve-

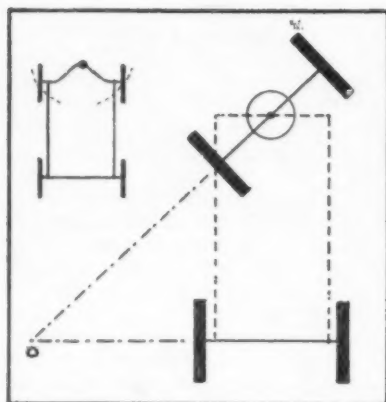


FIGURE 19

Mid-point or fifth-wheel steering is, as explained in the text, theoretically correct

hicles does not present any new problem as long as the two wheels not used for steering are on a common axis. The machine can, without slip of the wheels, turn about the point of intersection of the axis of the steering wheel with the common axis of the paired wheels. This of course holds whether the steering wheel be in front or rear. Tricycles and motorcycles with sidecars form common examples of this type of steering.

Occasionally in motorcycles, the sidecar wheel is set a few inches ahead of the rear motor wheel. In cornering with such a machine there must be slideslip of one or more tires over the roadway. The axis of the front steering wheel cuts the axis of the sidecar wheel at two separate and distinct points, so that there is no center about which the machine may turn without skid of a tire. The setting is correct only for straight running and it automatically tends to keep the vehicle on a straight course. It is stated that the setting counteracts a drag on the steering due to the unsymmetrical position of the sidecar.

WHEN a vehicle has three separate wheel axes, at least two must be mounted as steerers, and mechanism must be furnished to turn the steering wheels in such a way that, in all positions, the three axes are concurrent, that is, they intersect in the same point. Concurrency of wheel axes is the geometrical condition which must be satisfied if there is to be no sideslip of tires when curving. If one of the wheels which turns in the steering sense be mounted as a castor wheel, the concurrency condition will be satisfied automatically without the use of a linkage to harmonize the deflections of the wheels. Such a castor wheel was used in conjunction with the two driver-steerer wheels of the Vedovelli-Priestley electric automobile already referred to.

A tricycle with three separate axes

is shown in Figure 18. The two small wheels are mounted to turn as steerers. Short steering arms  $AB$ ,  $CD$ , connected by the coupler  $BD$ , turn these wheels in opposite directions so that their axes,  $AO$ ,  $BO$ , intersect on the axis  $EO$  of the driving wheel  $E$ . The linkage shown accomplishes this approximately. A much more elaborate linkage would be necessary to give exact concurrency to the three axes in all positions.

THE difficulty in satisfying the concurrency condition in the case of four-wheeled vehicles is avoided by adopting what is known as mid pivot, perch pin, or fifth-wheel steering. This is the arrangement on horse-drawn wagons, steam road rollers, and on several types of steam road locomotives. In this system of steering, shown in Figure 19, the front axle pivots as a whole about its middle point. In all positions of the steering we therefore

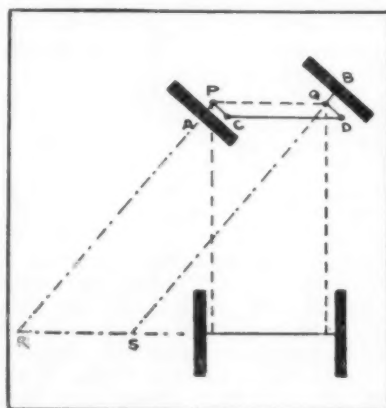


FIGURE 20

With divided-pivot steering, illustrated here, some skidding of the wheels must take place

get a single point  $O$  about which the vehicle will turn without any slipping of the wheels. The pivot is best placed slightly forward of the center of the front axle as indicated in the small diagram of Figure 19. This gives a castor action to the wheel pair; in horse carriages the advance is two to six inches or more. This is augmented by the set or rake of the perch pin which sometimes is pointed downwards and forwards some five degrees.

THE large effort required to turn the steering wheel, and the strain on the steering mechanism on account of the large lever arm of the unbalanced road resistance—the lever arm is half the wheel track—make mid-pivot steering an unsuitable system for high speed automobile work. A further serious drawback is that as the front axle is turned in cornering, the support for the car against overturning is reduced considerably. The defects of the mid-pivoted axle steering led Lenkersperger of Munich, to invent, in 1817, side-

pivot steering, Figure 20. This system as modified in 1887 by Jeantaud, a French carriage builder, is now in almost universal use in automobiles throughout the world.

With side-pivot steering, the two front wheels, Figure 20, are carried on short axles  $AP$ ,  $BQ$ , called stub axles, which are pivoted at  $P$  and  $Z$  to a cross member, the so-called front axle. The pivots  $P$ ,  $Q$ , are known as steering pivots, swivel pins, knuckle pins, or king bolts. Short arms  $PC$ ,  $QD$ , forming bell cranks with the stub axles and called steering arms, are connected by a coupler or track rod  $CD$ . Lenkersperger placed the steering arms at right angles to the stub axles so that the length of the track rod was equal to the pitch of the steering pivots. In consequence of this, the steering linkage  $PCDQ$ , Figure 20, always formed a parallelogram, gave equal deflections to the two front wheels, and maintained the axes of the steering wheels parallel to each other in all positions. The steering-wheel axes therefore cut the rear-wheel axis in two points,  $R$ , and  $S$ . The wheel  $B$  would steer the machine around  $S$ , while the wheel  $A$  would steer it around  $R$ . Actually, the car would turn about a point between  $R$  and  $S$ , some skidding of the wheels, which is undesirable, taking place to permit this.

IT has already been noted that for correct steering to obtain, that is, for all wheels to run without sideslip of the tire on the ground, the plans of the road wheel axes must be concurrent. The correct conditions are shown in Figure 21. Here, the car by turning about  $O$  gives each wheel a path on which it may run without skidding. From the drawing it will be seen that the inner steering wheel must be turned through a greater angle than the outer wheel in order to give the necessary concurrency to the axes. The excess turning of the inner wheel may be as much as six degrees.

(To be Concluded)

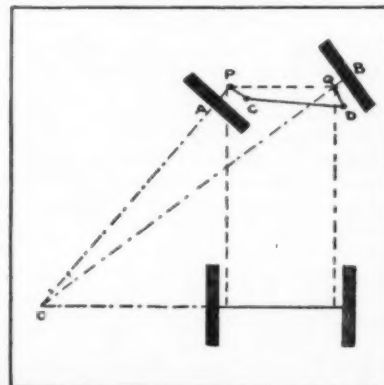
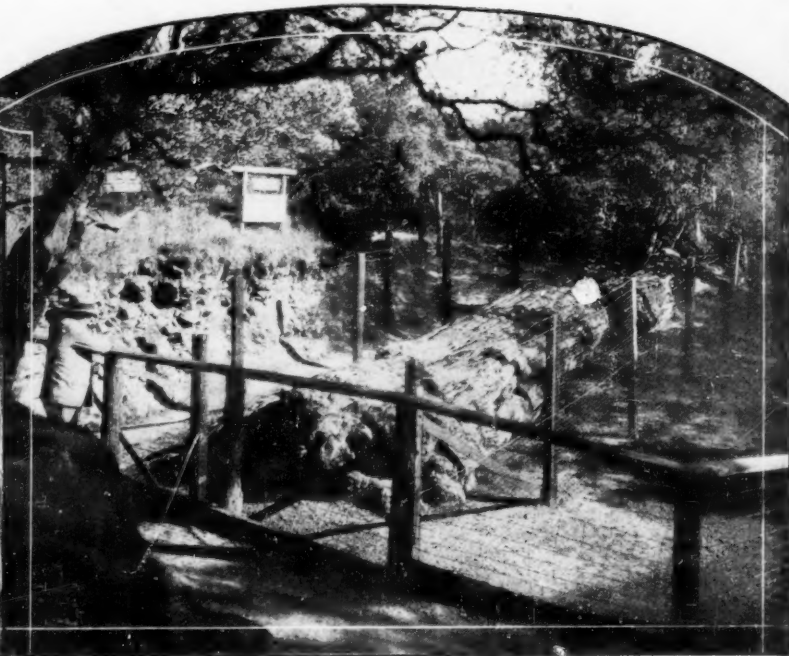


FIGURE 21

This modified form of divided-pivot steering gives more nearly accurate performance

**KNOTTY STUMPS**

*Stumps and chunks of hard stone "wood" in the petrified forest in Sonoma County, California*

**"QUEEN OF THE FOREST"**

*This immense petrified redwood which bears the above name is 80 feet long and 12 feet in diameter. The trunk has been split by a tree which sprouted through it and grew to large size*

## A Monumental Stone Forest

**I**N the foot-hill country near Mt. St. Helena, 45 miles northeast of San Francisco, there is a prostrate forest of trees which, due to petrification, serves as its own monument. Lying with their tops pointing away from Mt. St. Helena, these giant stone trees tell of a very ancient magnificent forest that was overwhelmed by lava flows from the mountain, was buried, and in course of time was petrified. They lie in two tiers, in an area a mile long and a quarter of a mile wide. The largest are 12

feet in diameter and 100 feet long. Volcanic ashes and sandstone that originally covered most of them have been eroded away by the action of the elements while others have been excavated since their discovery in 1871. The petrified forest is easily reached by automobile from Calistoga or Santa Rosa, California. It lies in a region of natural beauty only a few miles from Jack London's "Valley of the Moon" and from where R. L. Stevenson spent his honeymoon.

**A REDWOOD IN STONE**

*Erosion through the centuries partially uncovered this giant tree and the work of excavation of its full length has been done by man. It was originally covered with many tons of volcanic ash and sandstone*

### ◀ DEEP EXCAVATIONS

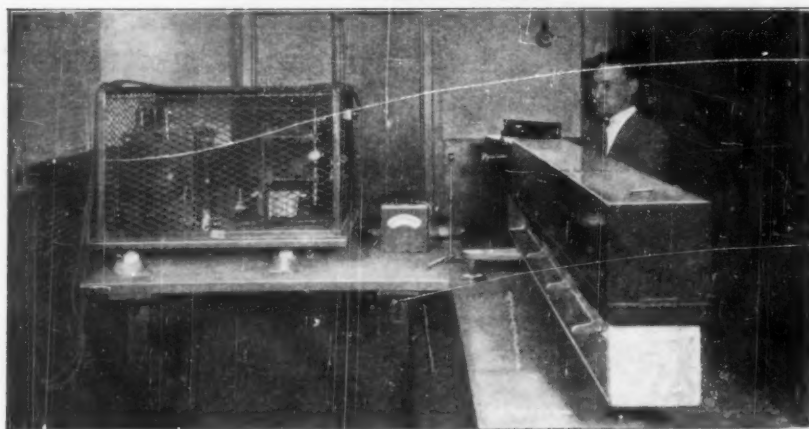
*Two smaller trees which retain their pristine form and structure to a remarkable degree being exposed to view by slow and careful removal of the overlying earth*

### TUNNELING WAS NECESSARY▶

*In some cases the petrified trees were still covered by hills that had not eroded, and only a part of them protruded. In order to uncover these, it was necessary to dig tunnels through stone, back into the hills*







A SPECTROGRAM BEING TAKEN IN THE LABORATORY

Figure 1: Compare the photograph with the diagram below, at right. In the set-up shown above, the photographic plate may be seen projecting above the case at an angle in the rear

## Spectrographic Analysis

### To a Growing Extent Industries and Laboratories Are Making Use of This Method of Determination, Simple and Far More Sensitive than Chemical Analysis

BY EARLE E. SCHUMACHER

Member of the Technical Staff, Bell Telephone Laboratories

CHEMICAL analyses both qualitative and quantitative are required daily in almost any laboratory. Some standard methods of analysis are slow, difficult, and costly, particularly when they are applied to the determination of small amounts of impurities. A shorter method is available, however, as it has been satisfactorily demonstrated in recent years that many of the more difficult analyses can be quite easily made spectrographically.

When an electric spark passes between two electrodes the intense heat developed vaporizes a small amount of the electrode material. The high potential on the electrodes ionizes this vapor and makes it radiate light of a definite group of wavelengths which are characteristic of the material. On the individuality of the radiation from each element, spectrographic analysis is based.

The electrical circuit producing the spark is shown in Figure 2. The es-

sential element is a transformer which steps up the regular 60-cycle alternating current from 110 volts to 11,000 volts. This high voltage is sufficient to produce a spark of satisfactory length.

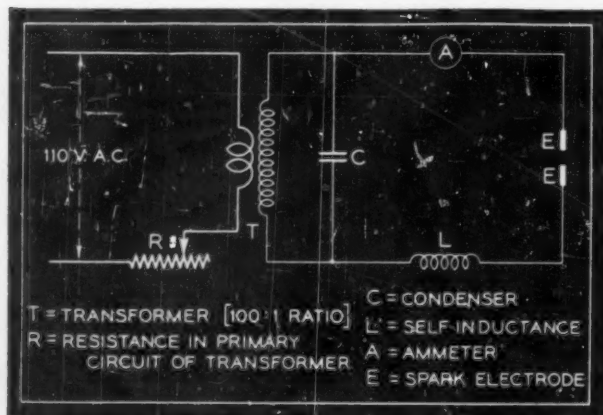
Substances to be identified are ionized in the electric spark and their light is passed through an optical system, consisting of lenses, a slit, and a prism, and finally photographed (Figure 3). In passing through the prism the light waves are bent through angles dependent upon their individual wavelengths and are recorded on a sensitized plate as a series of bright lines. The relative position of each line corresponds to the wavelength of the ray producing it and thus each element produces a spectrogram showing a definite and individual set of lines.

DISTANCES between spectral lines are measured with a comparator, a precise instrument that enables the position of all the sensitive lines shown in a spectrogram to be compared to those of any known element merely by making the required micrometer settings.

Since the most sensitive spectral lines for the majority of the elements are located in the ultra-violet region, the optical system is made of quartz which is transparent to these radiations, instead of glass which is opaque to them. The electrodes are generally made of the sample to be analyzed but, when this is not possible, graphite electrodes impregnated with the unknown material are used.

The spark spectra not only contain the characteristic wavelengths of the electrode material, but they also contain those of the surrounding atmosphere. These lines, due to ionized nitrogen, oxygen, and so on in the spark, do not cause any trouble in the identification of unknowns because they are the same in all spectrograms.

If the presence or absence of any element in a test sample is to be



ELECTRICAL CIRCUIT FOR SPARK SPECTRA

Figure 2: The transformer furnishes alternating current at 11,000 volts, giving a suitable spark. The intensity of the spark can be varied

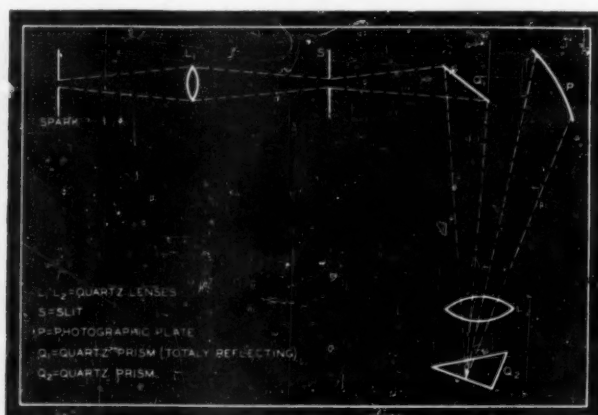
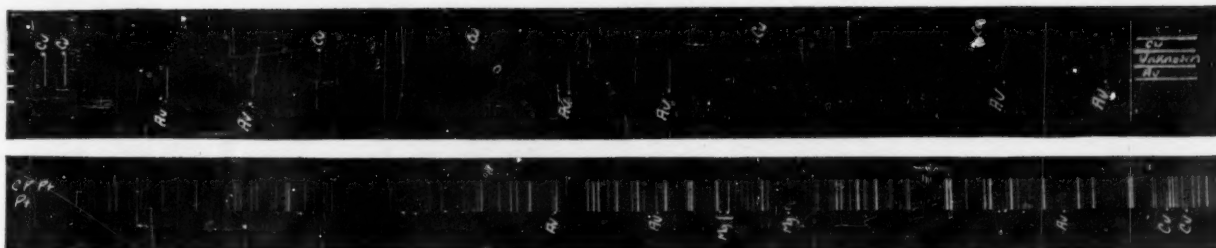


DIAGRAM OF HILGER QUARTZ SPECTROGRAPH

Figure 3: The refracting elements of the optical train are made of quartz because glass cuts off much of the desired ultra-violet spectrum



#### SPECTROGRAMS ILLUSTRATING ACTUAL CASES OF SPECTROGRAPHIC ANALYSIS

Figure 4, top: The spectrum of the unknown alloy, suspected of containing copper and gold, was juxtaposed to the spectra of copper (top band) and gold (bottom band). Both copper and gold lines extended into the spectrum of the unknown. Bottom: a similar example

determined, spectrograms of the sample and of the element sought are photographed side by side. After the plate has been developed the results are obvious. If the spectral lines of the known element continue through the spectrogram of the sample, the presence of that element is established.

Figure 4, at top, shows the application of this scheme to an unknown alloy which was thought to be composed of copper and gold. The spectra of copper, gold, and the unknown were taken in juxtaposition, with the spectrum of the unknown placed between the other two. It can be readily seen that the lines of the copper and gold spectra also appear in the spectrum of the unknown, which proves conclusively the presence of these two elements.

AMONG the practical qualitative applications of spectrographic analysis is the identification of the elements in a material when only a small amount is available. All large concerns are continually receiving small samples of materials bearing odd names such as "dreamium," "dubium," or "miraculum." These materials are supposed to have certain remarkable properties upon which the inventor has high hopes of capitalizing. Without undue exertion or expense a spectrogram will usually tell quickly whether the material is something new or simply an "old model" newly labeled.

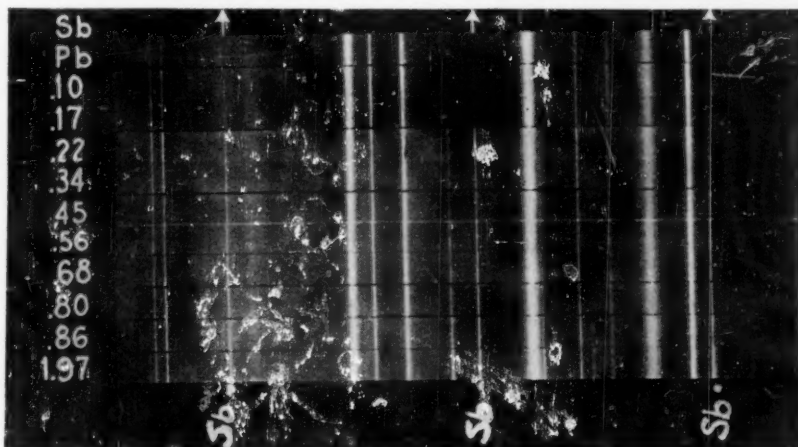
Another application is the identification of the elements in a valuable specimen without destroying it. The specimen itself is used as an electrode and the momentary spark necessary to make the spectrogram does not vaporize an appreciable part. Where alloys of different composition but similar appearance are handled in the same stock room the supplies oc-

asionally become mixed. Spectrographic analysis is particularly applicable in such a situation as it offers a rapid and simple method of identification. For example, some chemically pure platinum became mixed with slightly impure platinum. Figure 4, at bottom, shows spectrograms of both samples, spectral lines of gold, copper, and magnesium being plainly visible in one of them.

the element's whole spectrum is visible.

Generally, impurities ranging from .003 percent to 1.0 percent of the whole can be determined quantitatively by this method. The procedure is to photograph the unknown on the same plate with a graded series of knowns. With a microphotometer to measure the relative brightness of the lines, the unknown can be easily placed.

Figure 6 shows the spectra of a



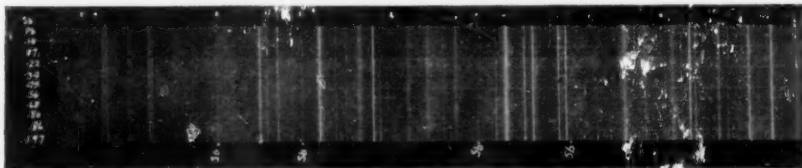
#### HOW SPECTROGRAPHIC ANALYSIS HAS BECOME QUANTITATIVE

Figure 5: First study Figure 6, below. Figure 5 is a section of Figure 6, enlarged. Here the decreasing strength of the antimony lines may better be studied. Percentages are indicated at left

Quantitative analysis is also possible with the spectrograph because up to a given percentage, different for each element, the intensities of the characteristic lines of an element are proportional to the relative amount of it in the substances. If one element occurs in another as a slight impurity only, none but the most sensitive characteristic lines of the impurity will appear in the spectrum. As the amount of the impurity increases, these lines become more intense, and new, less sensitive lines appear until

graded series of lead-antimony alloys containing from 0.0 to 1.97 percent antimony. As the antimony content increases, the antimony lines are seen to become more intense. Any unknown quantity of antimony in lead varying from 0.0 to 1.97 percent can readily be determined by comparing the spectrogram of the unknown with those of the graded series.

Spectrographic analysis is extraordinarily sensitive; authorities state that quantities as small as one 3,000,000th of a milligram of sodium, one 100,000th of a milligram of lithium, or six 100,000ths of a milligram of strontium or calcium can be easily detected. Practical quantitative applications of the spectrograph include the determinations of small quantities of almost all the elements. It is an interesting fact that the spectrographic method becomes more precise as the proportion of test element decreases, while the wet analytical method becomes less.



#### SPECTROGRAM OF A GRADED, QUANTITATIVE SERIES

Figure 6: All the lines marked Sb are those of antimony. Note how they become weaker as smaller percentages are involved. An enlargement of a portion of this spectrogram appears in Figure 5



SETTLING THE EARTH-FILL LAFAYETTE DAM

Soil, brought from borrow pits, is dumped on the dam, wetted, and rolled. Wetting is done by hose direct or by sprinkler truck. Note over-head pipes for supplying water to trucks and hose

## Some Unique Methods of Dam Construction

### *Building of Dams On the Gigantic Mokelumne Project Requires Much Ingenuity*

By CHARLES W. GEIGER

**T**HE Lafayette dam now under construction near Oakland, California, will be, when completed, the largest rolled earth-fill dam in the world. It will contain 2,000,000 cubic yards of soil, and will be 170 feet high (maximum), and 1855 feet long on the crest.

This reservoir, of 11,900 acre-feet capacity and covering an area of 915 acres, is to provide equalization, emergency storage, and a by-pass into upper San Leandro Reservoir, on the Mokelumne River water supply project.

**T**HE Lafayette dam will change the topography of the country where it is erected. It will completely fill the space between two hills about one and one half miles west of Lafayette. This great structure will be 850 feet thick at the base, narrowing to a 20-foot roadway at the top. The upper face will be concreted to prevent erosion by the wash of water and the lower face and top will be thickly planted with *Lermuda* grass to prevent movement of the earth by the rain water.

The area under the dam was stripped to a depth of one foot with an

elevating grader drawn by a tractor. Then the numerous six-inch and eight-inch tile drain lines under the lower half of the dam were laid. The cut-off trench was then excavated with an electric shovel and an electric drag-line. Fifteen thousand lineal feet of interlocking steel piling were then driven. On top of this was poured the concrete cut-off wall, which extends eight feet below and eight feet into the clay puddle core.

Some of the embankment material was secured from the reservoir floor, but the major portion is being excavated from a borrow pit about half a mile from the dam, hauled by motor trucks and dumped at the proper point in the embankment. A tractor operating a hydraulic bulldozer is used in spreading the material. The material is then spread evenly by means of a tractor drawing a leaning wheel grader. Compacting of the fill is accom-

plished with a 15-ton steam roller, and petrolithic tampers drawn by a tractor. This tamping equipment consists of a shell roller filled with water to give the proper weight and faced with ball-shaped feet. A sprinkler system for supplying water to settle the embankment consists of three lines of two-inch pipe suspended overhead longitudinally with the axis of the dam.

This dam is a part of the 39,000,000 dollar Mokelumne River water supply project for Oakland and other cities, in the construction of which many interesting types of machinery were developed.

**A** SECTION of the trench for the water pipe was dug by a trenching machine specially built for the project, said to be the largest trencher ever built, capable of excavating a trench seven feet wide and 16 feet deep. On one occasion this trencher cut, in four days, 4640 lineal feet in stiff clay and adobe. On one section much of the excavation was in hardpan; nevertheless the trencher cut right through it, the trench literally "smoking" at times from the grinding of the teeth through the hardpan. Progress made was about 300 lineal feet of trench 9 to 10 feet deep during each shift. Instead of changing the cutting-teeth on the buckets, the operators between shifts "sharpened" the teeth by welding on Stoodite.

The bell holes for the pipe were excavated with a traveling crane equipped with a clamshell bucket specially built for this purpose. This bucket has a bite-width of 10 to 11 feet, can



BULL-DOZING

A tractor operating a bull-dozer (a push scraper) which spreads the soil into depressions after it has been dumped



straddle a seven-foot ditch and excavate both sides of a bell hole at once.

One part of the project was built by the Atkinson Construction Company, whose camp is one of the finest ever installed, representing an investment with equipment included, of nearly 1,250,000 dollars. This part of the project, known as the Pardee dam, is a gravity type, curved dam and will require about three years to build.

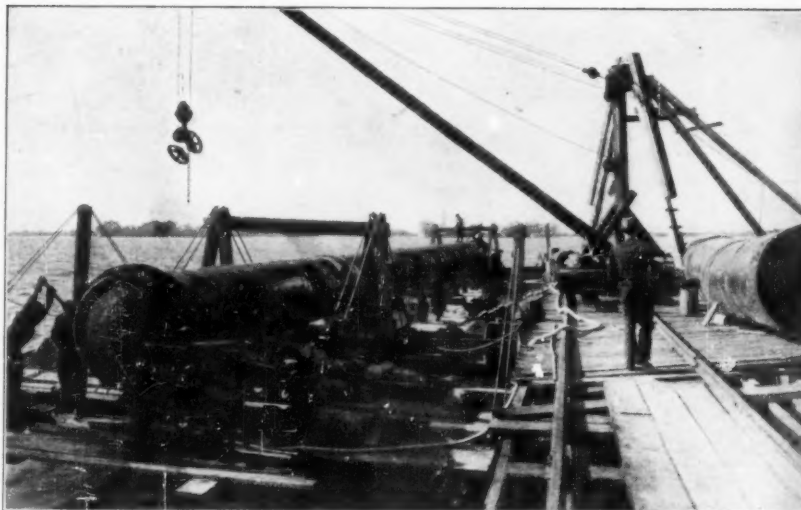
The concrete mixing plant and material bunkers at the Pardee dam site constitute, combined, one of the largest plants if not the largest, ever erected for dam construction.

**T**HE gravel screening and washing plant is unusually large and carefully designed, and cost alone about 250,000 dollars. The concrete aggregates are secured from the tailings dumps left by gold dredges which operated a few years ago in the bed of the Mokelumne River where it emerges from the canyon proper, about six miles down stream from the dam site.

From the bunkers, screened and washed gravel, sand, and rock are carried by an aerial tramway, more than four miles long, across the mountains. This tramway extends from the gravel plant, over many ridges and canyons to a summit in the center of a big bend in the river, and then across the river on a long angle, to the bunkers at the concrete mixing plant. The installed cost of this tramway was about 250,000 dollars.

A flume with a capacity of over 12,000 second-feet, one of the largest, if not the largest, ever built, was constructed by the contractor to take care of the flood water in order that the pouring of concrete could proceed during the winter and so avoid having the expensive equipment lie idle.

Three crossings of the San Joaquin River made by the pipe line were very interesting. The pipe for the river crossings was delivered in 30-foot lengths on barges, and stored on pipe racks sufficiently large to hold a com-



#### PIPE SECTION FOR THE RIVER CROSSING

*Section of 54-inch pipe, to be used in crossing the San Joaquin River, on a barge just after receiving a 24-hour test under high pressure. It is now ready to receive its coating of "gunite"*

plete river crossing of approximately 1200 lineal feet of 54-inch pipe. It was then placed in cradles on barges and assembled into sections 150 feet in length. Generally, two sections were assembled on each barge. At the ends of each section a cast steel flange was bolted, the sections were filled with water, and a 24-hour test under 250 pounds pressure was made. At the conclusion of the test the pipes were given a covering of "gunite" four inches thick, reinforced with two layers of wire mesh and  $\frac{3}{8}$ -inch bars.

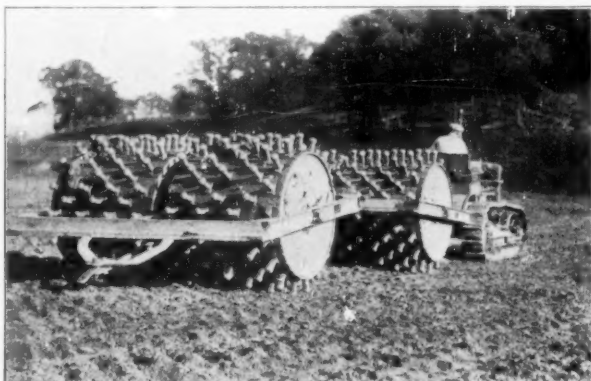
**A**FTER the "gunite" had cured, the water pressure was released from the sections, the test heads were removed and temporary steel plate heads and rubber gaskets were bolted to the flanges, in their stead. These were to act as water-tight bulkheads.

Removal of the sections from the barges was accomplished by submerging the barge until the pipe became buoyant and then towing the sections from over the barge. This method allowed the long sections to enter the

water uniformly and slowly, thus eliminating any danger of undue stress such as might be caused by launching the pipe from skidways.

The submerging barges were ballasted with sacks of sand sufficient to overcome buoyancy. Also, water-tight bulkheads were installed, making six separate compartments, each fitted with flood gates and relief valves to provide for balancing the barge during its submersion and raising.

The pipe-laying equipment consisted of two 120-foot barges connected by means of trusses, one at each end. Large multiple blocks were suspended from the trusses and carried steel cradles into which the pipe sections were secured for lowering. After the sections had been floated into the steel cradles, the floating heads and rubber gaskets were removed, and the entire load was then controlled by steam donkey engines which were a part of the barge equipment. A lead gasket was placed between the steel flanges and the connecting bolts were then put in place by divers.



#### COMPACTING WITH PETROLITHIC TAMPERS

*These rollers, filled with water to give weight and covered with projecting ball-tipped spikes, were drawn over the loose soil by tractors*



#### RAIN AND MUD CAUSED NO DELAY

*Huge six-ton sections of 54-inch pipe were hauled by tractors. When completed, the pipe line will carry water to several California cities*



A COAST DEFENSE MONSTER SPEAKS

Navy type, 16-inch gun on barbettes carriage for coast defense. This gun hurls a projectile weighing 2100 pounds, its maximum range being about 30 miles with a charge of 702 pounds of powder. Its rate of fire is one round per minute. The mount has been adopted as standard

## Our Latest Peace Insurance

*With World War Experience As a Guide, Ordnance Experts Prepare, Not For, But Against Another War*

By F. D. McHUGH

AT the recent demonstration of ordnance matériel at Aberdeen Proving Ground, Maryland, Colonel James L. Walsh, Chairman of the Defense Division of the American Society of Mechanical Engineers, told of the following incident:

"During the World War, a contractor having more patriotic zeal than knowledge of the situation, insisted that he be awarded a very large contract for fire-control matériel." Fire-control matériel, as anyone acquainted with army matters knows, consists of a variety of complex range-finding and altitude-finding equipment. "This manufacturer claimed that his plants had had much experience in the manufacture of this equipment and he was sure he could handle a sizeable job in its production. It developed that he was, as a matter of fact, a very large and successful manufacturer of fire-extinguishers—those little blue bottles we used to see hanging on the wall marked 'For use in case of fire.'"

IF large manufacturers were as ignorant of the necessities of war, during war time, as indicated by this story, one can hardly imagine the extent of the layman's ignorance. But the World War caught us unprepared and, despite the great amount of publicity

given to war matters and the tremendous organizations built up to produce war materials, the country was slow to learn because it had to start from the beginning.

Today, without the necessity of our maintaining huge supplies of expensive equipment, the situation would be

different should war in protection of our sovereignty be necessary. We have been taught preparedness, and have prepared—by the education of industry: industry has been shown just what would be expected of it in case of war. The country has been divided into 14 industrial districts to



105 MILLIMETER GUN FOR SEACOAST OR FIXED DEFENSES

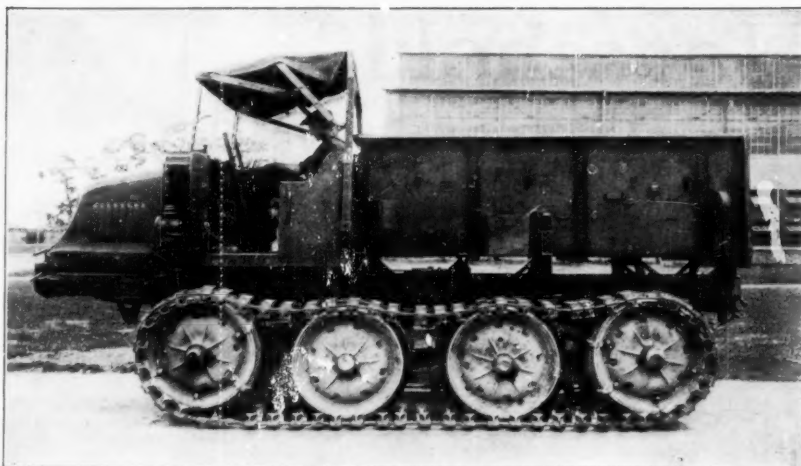
Loaded by a pneumatic rammer, this gun can fire about 15 shots per minute. It fires either 33-pound shells or shrapnel at a vertical range of 12,000 yards and a horizontal range of 19,000 yards.

each of which has been allocated a quota of the articles it can manufacture. Also, powerful national societies have organized to foster a spirit of preparedness. One of these is the American Society of Mechanical Engineers which has a National Defense Division; another is the Army Ordnance Association, numbering many thousand civilian members—engineers and manufacturers—which was organized to co-operate with the government and “keep alive an interest in and a knowledge of the design, production, and maintenance of munitions.”

With the co-operation of these, the Ordnance Department has worked constantly to improve, develop, and perfect ordnance matériel, and as a result, our present matériel represents a tremendous advance over anything possessed during the war and is the equal of that of any other nation today. But the solution of the problem has not yet been attained.

**F**OR example, time and money must be saved “from the blueprint to the finished product.” The solution of this may resolve itself into the giving of “educational orders” to manufacturers, not on a competitive price basis, but for the knowledge it will give them of how to adapt their plants to the production of particular pieces.

The recent demonstration at Aberdeen Proving Ground was an educational event of great importance. Association members, engineers, and manufacturers were shown ordnance matériel in a spectacular display, and thus were given a comprehensive idea of the ordnance problem. A huge 16-inch gun on a barbette carriage and permanent emplacement, a 12-inch gun on a railway carriage, and numerous smaller guns were fired. Day and night firing of anti-aircraft guns,



A CAISSON TRACTOR-TRUCK

*Guns are useless without adequate supplies of shells. This photograph shows a three-ton tractor caisson developed by the Ordnance Department for speed on the road or in soft ground*

the effectiveness of air bombs, motorized artillery of many unique types, and tanks in action were demonstrated.

One of the most remarkable developments in ordnance matériel shown is the electrically-operated automatic range-finder and fire-control apparatus which may be used on the three-inch gun or on machine guns. The turn of a wheel or two sets in action the delicate mechanism that picks up the sound waves from an airplane, actuates the controls that determine the altitude and distance of the airplane, and aims the multiple-mount of guns. Fog or clouds could not screen an airplane from the effective fire of guns controlled by this mechanism, the details of which are being kept secret.

The Browning automatic 37-millimeter anti-aircraft gun is another great achievement. It fires 60 shells per minute, each weighing one and one quarter pounds, with the enormous

muzzle velocity of 2800 feet per second.

One other very recent development, the new mount for the three-inch anti-aircraft gun, should be mentioned here since it is a radical departure from the wheeled types hitherto tried and discarded. The new mount consists of four long steel beams that lie flat on the ground, spreading out from the gun platform. It can be prepared for action in about 10 minutes and as quickly restored to marching order.

The gun used on this mount is the recently adopted standard three-inch piece which throws a 15-pound shell to a height of 12,000 yards and 19,000 yards horizontally. Its rate of fire is up to 30 rounds per minute. In this gun, the barrel liner, when worn from constant firing, can be removed and replaced by a new liner, under field conditions, in about 30 minutes, thus obviating slow and costly trips to the arsenal for relining.



Herbert

THE MACHINE GUN'S BIG BROTHER

*One of the newest pieces of ordnance, the Browning 37-millimeter automatic gun. Shells are fed into the gun in clips of five as shown*



MACHINE GUNS IN ACTION

*The airplane target of this group of guns is located and the guns are aimed and fired by the automatic electrical range-finding equipment*



# Household Inventions



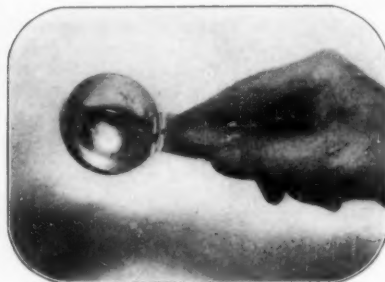
## INSECT CONTROLLER

Getting into the crevices where insects breed and multiply may now be done efficiently with the equipment shown above and to the right. The special container full of insecticide is attached to the handle of a vacuum cleaner and the blower attachment then thoroughly spreads the insecticide.—*Airway Electric Appliance Corp., Toledo, Ohio*



## NON-SLIP HANGER

A push on the triggers of this device causes the upper arms to fly up. When a button is pushed, the padded arms spring down on the garment.—*Kno-Fall Garment Hangers, Inc., 720 Madison Ave., New York*



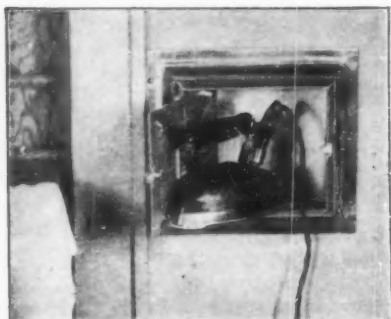
## SERVING SCOOP

Like the "cut-out" scoops used for ice cream at soda fountains, this new one of aluminum is sold in five and ten cent stores. It is useful for serving ice cream, rice, or mashed potatoes.—*Lorraine Metal Mfg. Co., New York*



## DUSTLESS FIREPLACE

Despite the very modern heating equipment of today, the open fireplace is still in vogue. Thus there remains the problem of ash removal. The illustration at the left shows a skeletonized fireplace which has a special ash trap and chute to the basement. Above is shown the trap. Instead of shoveling the ashes into a can and carrying them out, all that is necessary when this device is installed is to give the lever a pull and the ashes fall into the basement.—*Fireplace Devices Co., 136 W. 83rd St., New York*



## ELECTRIC IRON CABINET

To be installed in the wall next to the folding ironing board or other convenient place, this cabinet prevents electric iron fires. The hot iron may be safely closed in the steel and asbestos cabinet.—*The Cunningham Mfg. Co., Los Angeles, California*

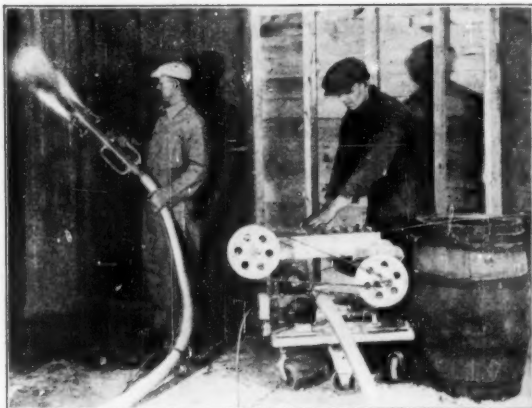


## BATHROOM DRESSER

A handy cabinet that takes only a few inches of floor space and offers a dresser top for toilet articles, an open shelf for towels, storage shelves for soaps, sponges, brushes, et cetera, and a ventilated compartment for soiled linen. It is made in several sizes to be set into or against the wall.—*El Paso Sash and Door Co., El Paso, Texas*

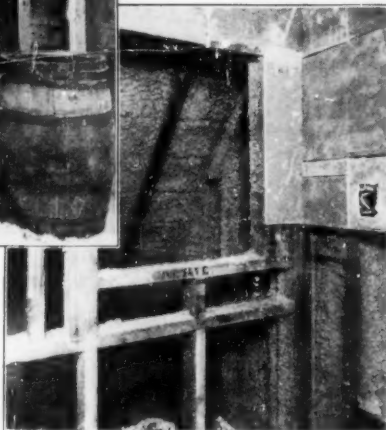
# Inventions

## New and Interesting



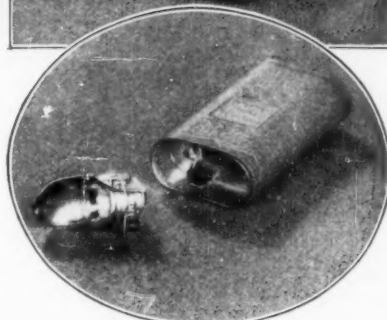
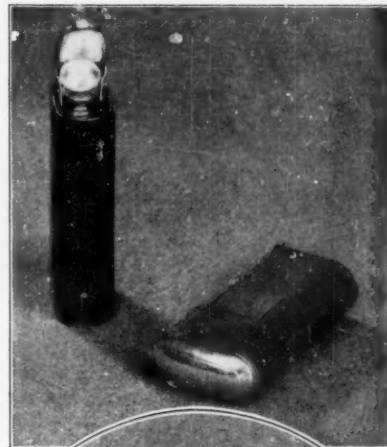
### FIBROUS WALL INSULATION

A new form of insulation against heat and cold for buildings. It is sprayed on the inside surface of sheathing between wall studs by means of compressed air. It is made of pulverized newspapers and magazines to which a fireproofing chemical is added during the shredding process. The binder for holding it in place after spraying is silicate of soda (water glass). It can be applied to practically any kind of building surface in thicknesses of one half an inch up to the full depth of the studding. This material closes openings around pipes, electrical conduits—in fact, goes into all openings in the walls, and insulates against sound and temperature changes.—*Sprayo-Flake Co., 56 South Bay St., Milwaukee, Wisconsin*



### DAYLIGHT LAMP

A lamp which, according to the results of tests, emits light having a color temperature the same as that of the sun. It utilizes a gas-filled, blue-glass bulb. This bulb is surrounded by a large number of mirrors tinted in different colors and placed in definite combinations to correct the spectral composition of the light without absorption.—*Sunlike Illuminating Co., Inc., 21 W. 19th St., New York*



### FLASHLIGHT

Somewhat similar in appearance to the pocket cigar lighter, this flashlight is compact, and easily carried in pocket or purse. It lights automatically when the top is opened. Closing the snapper top cuts off the light. Parts have been reduced to a minimum; it has no case or switch.—*Burgess Battery Co., Harris Trust Bldg., Chicago*



### SELF SUPPORTING SCREEN

An ingenious screen for showing amateur motion pictures in the home. No nails or finding of wall space is necessary as it will stand on any table, the carrying case being heavy enough to act as a base. Uprights are hinged for folding.—*The De Vry Corp., Chicago*



### HEAT TABLET AND SPECIAL UTENSILS FOR USING IT

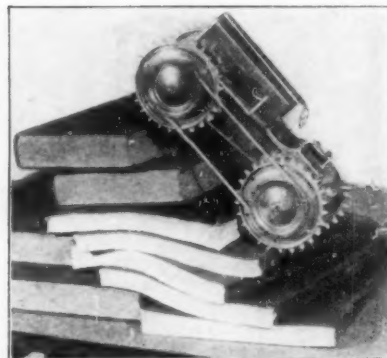
In the lower right hand corner may be seen a box of heat tablets which look like elongated sugar tablets. They are a new importation from Switzerland. The tablets burn with a hot, blue flame like that of alcohol, but will not melt or evaporate. They are light weight, practically odorless, and non-explosive; and may be used safely anywhere.—*Irving Puttmann, 420 Lexington Ave., New York*

# Inventors Turn to Toys



## ◀ LOCOMOTIVE

This locomotive is made for the boy who likes to build his own, for it comes "knocked down" packed in a box. It is assembled or taken apart by following instructions; and parts may be replaced. — *Dorfan Co., Newark, New Jersey*



## CLIMBING TRACTOR

Over castles and forts of building blocks, over sand piles, books, or hurdles, or up an incline of 55 degrees, this powerful toy goes without faltering. It will pull small trailers with heavy loads or stand on its nose and travel along—*Animate Toy Co., Inc., 200 Fifth Ave., New York*



## ▲ CHAUTAUQUA DESK

A folding desk equipped with green chalkboard, educational scrolls in a large variety of subjects according to the age of the child, chalk, et cetera, that will give the child's imagination full play. It develops art talent.—*Lewis E. Myers and Company, Valparaiso, Indiana*

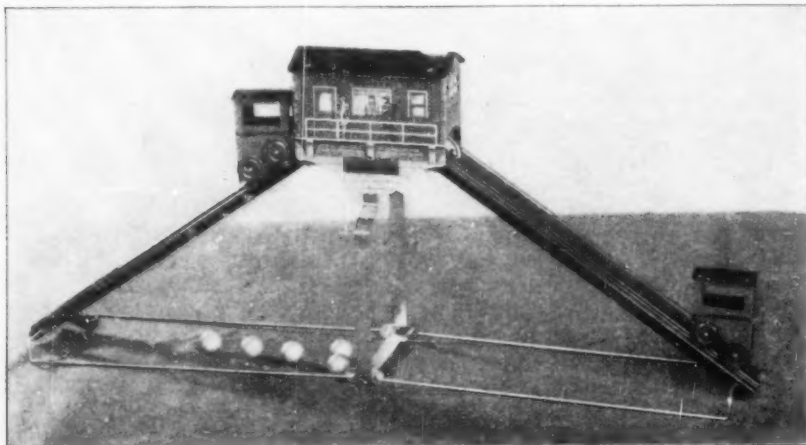


## ▲ INDOOR GOLF GAME

Putting, approaching, digging out, all are the same in this game as in one on the links. The force of a stroke, as shown by an indicator, is recorded on the "course," which is a separate board, by moving forward a marker. The struck ball is recalled by a spring.—*Play-golf, Inc., 641 Union Trust Bldg., Cleveland, Ohio*

## ▼ CABLE CAR

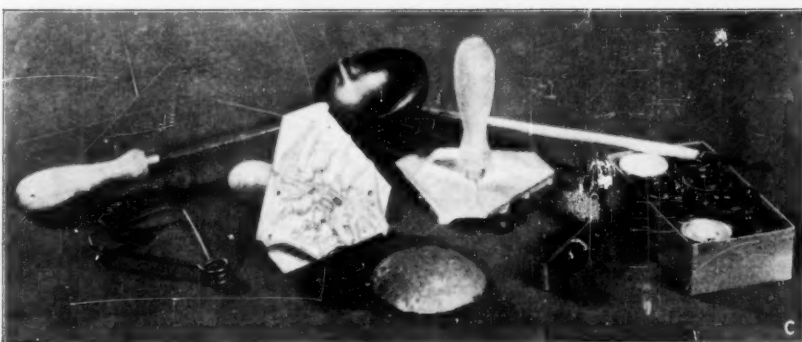
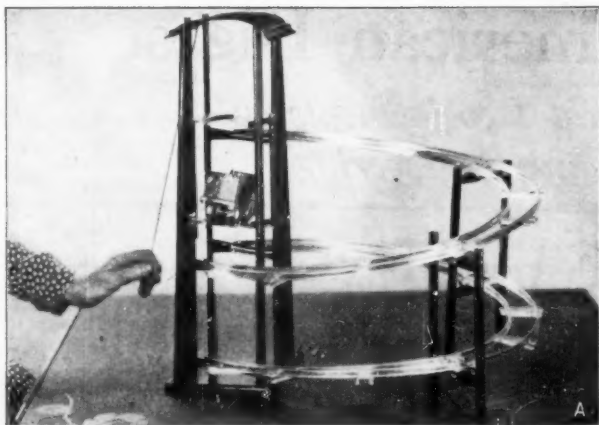
The cars of this toy ascend and descend alternately if balls are kept in the hopper at the top.—*R. H. Macy Co., Broadway at 34th St., New York*



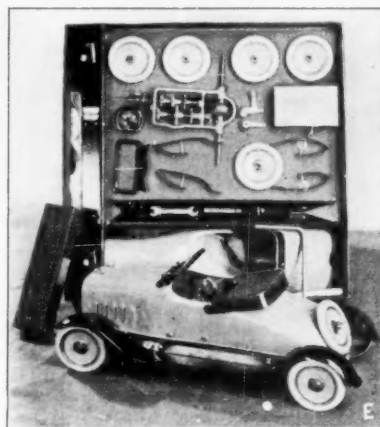
## ▲ GALLOPING HOBBY HORSES

Moving legs on this horse are so arranged that the natural rocking motion of the child causes it to go forward at a gallop. This toy is made of heavy plywood with metal bolts and reinforcing plates, but it is light enough for the child to carry around. Finished in lacquer.—*The Go-pony Co., Rockford, Illinois*





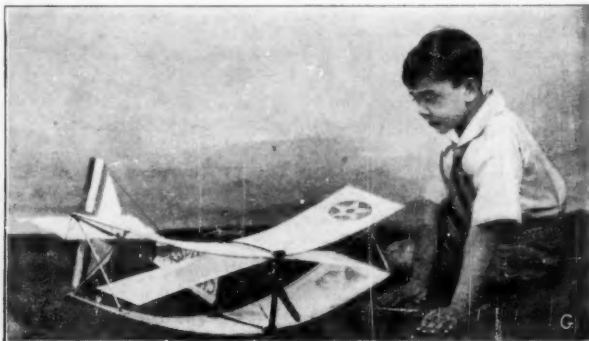
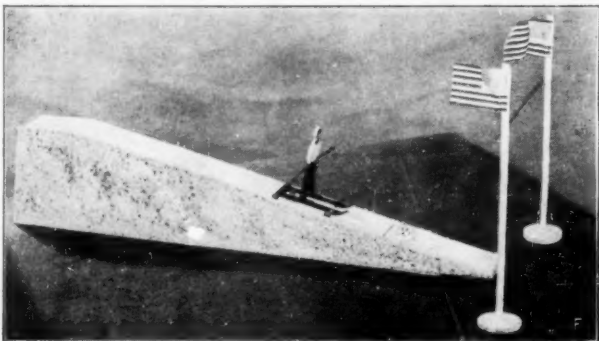
exercise his or her wits to the fullest. The child receives it in "knocked-down" condition, packed neatly in a box. A little work according to instructions, with the screw-driver and wrench that are supplied, and *presto*, there stands the complete automobile. It can then be taken



ON this page is illustrated a group of toys that will delight the child who has a mechanical turn of mind. The photograph lettered *A* shows a spiral track upon which a toy railroad gondola runs. When the car reaches the bottom, it is caught by an elevator which is then lifted by means of a cord to the top position where the car may again start its speedy trip to the bottom. Photograph *B* is a swimming pool which includes a dressing room for the doll swimmers, diving platform, and a shower. The shower is a miniature pump, operated by a lever, which lifts the water from the main basin up to the shower head. *C* shows a set of lead-molding tools with which lead soldiers, knights, or other figures may be cast. The set consists of a ladle for melting lead over a flame, molds, tongs for handling the hot figures, lead, and paint for decorating the figures after they have cooled. Although the cow shown in *D* is only a toy, she can be made to give milk and the child who plays with this toy will get a great deal of amusement out of milking her.

The secret of this lies in the tank within her body into which milk—or chalk and water—may be poured through the opening in her back. The automobile shown in *E* gives the ingenious child a chance to

apart and assembled as many times as the owner may wish. A ski-jumper that really jumps is shown in photograph *F*. When the figure, which is mounted on skis with wheels, is placed at the top of the incline, it races down, hits the trigger near the bottom, and is vaulted by the mechanism over the bar between the two flag-poles. Sometimes he doesn't quite make it and his skis catch on the rod. This serves simply to make him turn a somersault and then go over the rod. *G* shows a new airplane kite which, when flying, looks just like a distant plane.—*F. A. O. Schwarz, 303 Fifth Ave., New York*



# The Scientific American Digest

## *A Review of the Newest Developments in Science, Industry and Engineering*

### Evolution of a Tanning By-product

**C**ONSPICUOUS among manufacturing successes are those industries which have properly appreciated the commercial value of their by-products. The story of the packers would, indeed, be different reading if meat were the only article ever offered for sale by that industry. This is no less true of other industries. The

and, as a result, scientific laboratories are becoming indispensable in manufacturing.

Remarkable things have been accomplished with hair, the tanner's by-product which was once considered worse than worthless because, so far as was known at the time, it filled no important need and its disposal often boosted factory costs. Practically the reverse is true today.

This one-time waste product has been transformed from an article which manufacturing operations had rendered unmarketable, into a commercial article, displayed in the sales rooms of our best stores, purchased by discriminating women and, in its variety of uses, a home luxury.

In the walls of many homes, cattle hair in the form of a felt building blanket, insulates against cold in winter, heat in summer, and against sound every day of every season.

Rug and carpet cushions made of hair are rapidly becoming nationally known articles. Manufacturers of plushes, carpets, and yarn, are using hair in the fashioning of articles which interior decorators show with pride to customers who demand and pay for the best. Hair and hair felt are important articles in the manufacture of upholstered furniture.

In the latest car models at the automobile shows, in slippers of many shapes and shades, in gymnasium mats, on church benches, on household ironing boards, around ice cream and milk cans—these are a few of the many ways in which this by-product of the tanning processes has been adapted to, and made an important part of, the commercial products of today.

There are no apologies needed for this protective covering which nature has provided for animal life. It insulates the skin from heat and cold and protects the body from bruises and abrasion. It is not supplied with nerves and has great durability. On fish and reptiles, the protective covering takes the form of scales, and on

birds, feathers. In mammals it is the fine thread-like substance of many textures and colors known as hair.

No species of mammals is without hair. It varies from the finest and softest down on a lady's cheek to the coarsest bristles of the hog and the stiff quills of the porcupine.

Hair is the last part of the body to decay, is believed to grow even after death, and is known to last for centuries. In a Chicago bank window display of Indian relics, there is exhibited a woman's scalp taken by some Indian brave more than 100 years ago. The hair shows no effects of age. It is not dissimilar in color and in texture to the shorn tresses of any modern girl. Even when exposed to the elements, hair will not deteriorate and can be dissolved only by heat under pressure or in the presence of alkalis or acids.

The largest use of hair for manufacturing purposes is in the form of felts. Hair felts vary from the thick, loosely felted goods which are used for upholstery and insulating purposes, to the hard felts which are used for glass and stone polishing, slipper soles, washers, and cartridge wads. Hair felt is recognized as the standard insulating material for refrigeration plants and is used on the majority of refrigerator cars in this country. In this service, it provides high-test insulation from heat and cold.

Punched felt is used extensively as pads for laundry flat work ironers. As an upholstery material, hair felt has a wide use in the furniture and automobile trade as well as in car seats.

A higher grade of felt, in which the hair is more carefully carded before felting and the fabric is full after felting, also uses large quantities of hair. In this class of goods are the shoe, sole, cushion, polishing, and cartridge felts. For shot-gun shell wads, the longest and highest priced cattle hair is used, while in the insulating felts, short and medium hair is used.

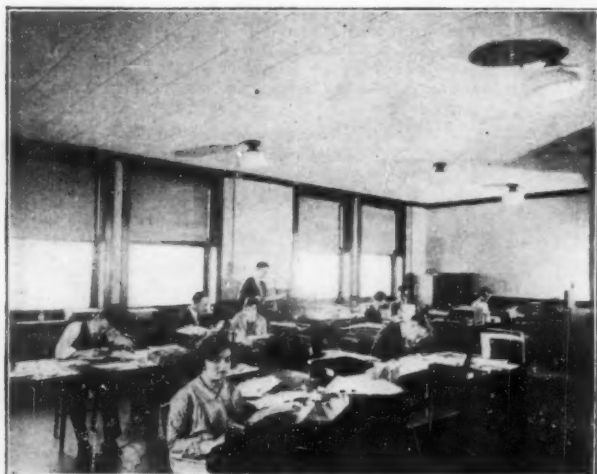
Coarser goat hairs are used for stuffing



At the top of this illustration is shown a chair seat pad filled with felted animal hair. At bottom is a felt polishing washer

utilization of by-products is one of the so-called "success principles."

It has not always been easy to make a success of by-product utilization. In most cases, years of scientific research and painstaking study have preceded any attempt at merchandising. Experience has justified this preliminary expense and research



Offices where quietness is conducive to efficiency, use hair felt to deaden sound in typewriters, walls, et cetera



Applying hair felt in sheets to the ceilings and walls of radio broadcasting studios where quiet is necessary

in the upholstery trade and also in the ready made or hard wall plaster trade. The finer grades of goat hair are used in the spinning trade.

Hair is now successfully blended with wool—which is but a particular form of hair—to produce yarn and cloth which,



Attractively decorated application of hair felt to an office building for the correction of acoustics

in many cases, is considered equal in quality to pure wool, and superior to wool and cotton, or wool and shoddy mixture. In the carpet industry especially there is a large use of spinning hair. Calf hair is used in the manufacture of plush as well as of felt.

Tanners now have a proper appreciation of the real value of this by-product. A definite educational campaign has been carried on with this end in view. As a result of this, the quality of the hair as it comes from the tanneries has steadily improved. More attention has been given

to the proper removal of the hair and to the processing after the hair is removed.

As a result, the product has come to the market with a stronger fiber, with no lime, dirt or other foreign material. As this improvement took place, new uses, which would have been impossible if the raw material had not been subjected to various improvements, were found for goods manufactured from hair, so that now the product has been lifted to a high place of respectability.

#### End-squaring and Packaging Lumber

CARPENTERS and builders have long recognized that "squaring up" the ends of boards with a hand-saw to make them suitable for use on the job is an economic waste. Since practically every board has to be made "four-square" before it can be used, the operation of sawing off the rough ends as they come from the lumber yard consumes no small part of the carpenter's time which could be devoted to the refinements of his craft were this not necessary.

A solution of this problem which is expected to speed up the carpenter operations on a building job has been worked out by the Weyerhaeuser-affiliated companies whose mills are in Minnesota, Idaho, and the Pacific Northwest. Their development engineers have invented a saw which will cut across the grain of a board, leaving a surface as smooth as if it were planed.

Instead of shipping its lumber with the ends of boards rough, as is usually done, these mills have added one more manufacturing operation to their routine: that of making the ends of each board of the selected lumber four-square, and shipping it in packages held together with a specially designed fiber end-cap.

The re-butting process and machinery and the method of packaging the bulky commodity were evolved after many months of experimentation. The saw is set at exactly 90 degrees to the lumber to be cut. The saw-teeth are so ground on the arbor as to insure each tooth traveling in a

true circle, thereby giving a smooth cut.

A belt conveyor brings the boards to the saw in stacks of three to six, according to the thickness of the wood, and they are gripped by guides operated pneumatically and faced with rubber.

The revolving blade is then swung down, being operated on some machines by an electric push button and on others by a lever. After the saw has passed through the wood another belt carries the boards to the other side of the trim-bench so that the other ends may be cut off.

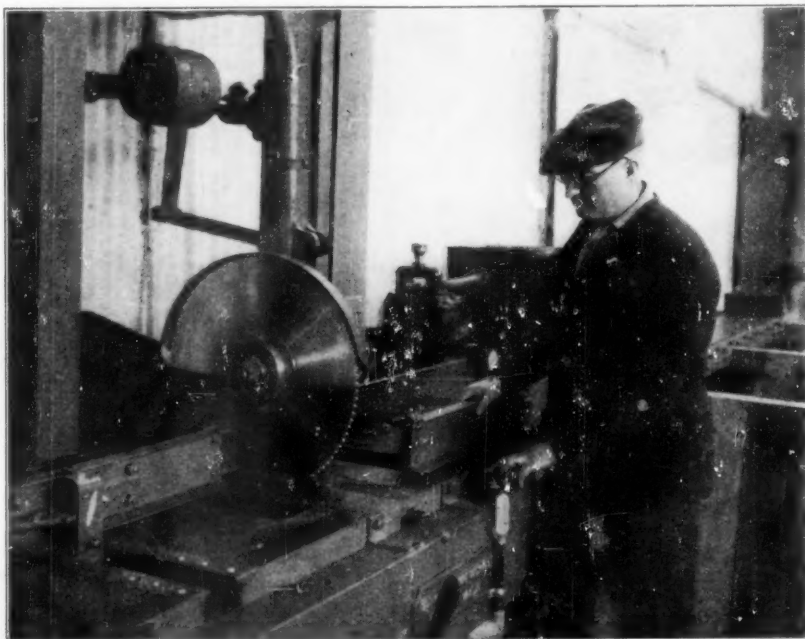
When both ends have been trimmed, there remains only to affix the end caps, and the package of lumber is ready to be shipped direct to the job.

#### American Dirigibles to Dwarf "Graf Zeppelin"

WHILE the *Graf Zeppelin*, world's largest airship, dwarfs her sister, the U. S. S. *Los Angeles*, American dirigible designers and enthusiasts are looking forward to 1931 when the all-American ZRS-4, a dirigible nearly twice the capacity of the German dirigible, will take the air. A little less than a year later the ZRS-5,



Caps of strong fiber, and bearing the species and grade of the lumber, are placed over the ends of lumber that has been square-sawed



The saw that cuts off the ends of boards exactly at right angles, has teeth pointing straight within the plane of the blade. The ends are left square

a sister ship from the same patterns will be produced here in America by the Goodyear Zeppelin Corporation as the result of a contract signed by the United States Navy just a few days before the *Graf Zeppelin* left Germany.

Even earlier, the *Graf Zeppelin's* world dirigible title will be challenged, for in England two dirigibles, both of 5,000,000 cubic feet capacity, are nearing completion. They are John Bull's bid for supremacy in the air lanes as well as on the sea's surface. America may expect visits from the R100 and R101 in the spring, although they may be flight-tested on the air routes to Egypt, India, and Australia, for which they were designed.

Not discounting the achievements of the *Graf Zeppelin's* flight, airship experts note that the new German airship is an enlarged edition of the ZR-3, now the *Los Angeles*, which four years ago made the same transatlantic crossing from Friedrichshafen to Lakehurst on its way to join the United States Navy. Twenty-eight ballonets in-





Highway surfacing machine for cutting down high spots, irregularities, uneven expansion joints, and repaired patches. It is run by air-cooled gasoline motor and mounted on wheels for quick transportation. The swivel castor in front is raised by lever, thus lowering cutter head to make contact

stead of 24 make the *Graf Zeppelin* 771 feet long instead of 658 feet. The diameter of the *Graf Zeppelin* is only 10 feet greater than that of the *Los Angeles*. Both have five engines and their external appearances are similar. The principal difference in the interior is accommodation for the gas fuel ballonet at the bottom of the large envelope and an extra corridor or "cat walk" running the length of the German ship.

The new navy airships, when completed, will be only 14 feet longer than the *Graf Zeppelin*, but they will be 132.9 feet in diameter and hold 6,500,000 cubic feet of gas compared with the *Graf Zeppelin's* 3,708,000. The American ships will incorporate some new design factors that promise to make them unique.

Due to the use of inert helium instead of explosive hydrogen for inflation, it will be possible to place the eight engines inside the hull. Engine specifications have not been announced, but it is considered probable that gasoline will be abandoned for heavy oil fuel. The internal engines will allow the ship to slip through the air with less resistance and there will be less danger of the engines being torn off in a severe storm. A complete airplane hangar will be housed within the hull from which five airplanes can be launched from a trapeze, like performers at a circus.

The framework of the new dirigible will have a strength unequalled in any other design. Made of duralumin, the favorite dirigible metal because of its lightness, every portion of the frame will be close to corridors and passageways and accessible for inspection and repair even during flight.

—*Science Service*

#### Manless Power Station

**A**N electric distributing station that will ultimately be able to supply power sufficient to light the homes of approximately 300,000 families and will be operated without a human being inside its walls, was placed in service on September 17, at 238th Street and Spuyten Duyvil Road, New York City, by The New York Edison Company.

This manless station, one of the largest in the world to be operated without a

single attendant, will be controlled from another station more than three miles away. The distant operator can close or open any switch, placing in service the various transformers and circuits in the new station, simply by pressing keys which send over wires electric impulses of the dot and dash system used in telegraphy. Also he will receive automatic signals from the station which will inform him whether the equipment is functioning properly.

It will be necessary for human beings to visit the station only once a week to inspect the apparatus. A complete burglar alarm system on windows and doors and other places will protect the building electrically.

This control system was devised by the Westinghouse Electric and Manufacturing

125 by 85 feet in dimensions, and one tall story in height. It is one of the numerous distributing stations of The New York Edison Company system. This station will receive from the generating stations current at 13,200 volts and distribute it at 2300 volts over its feeders which supply the street mains.

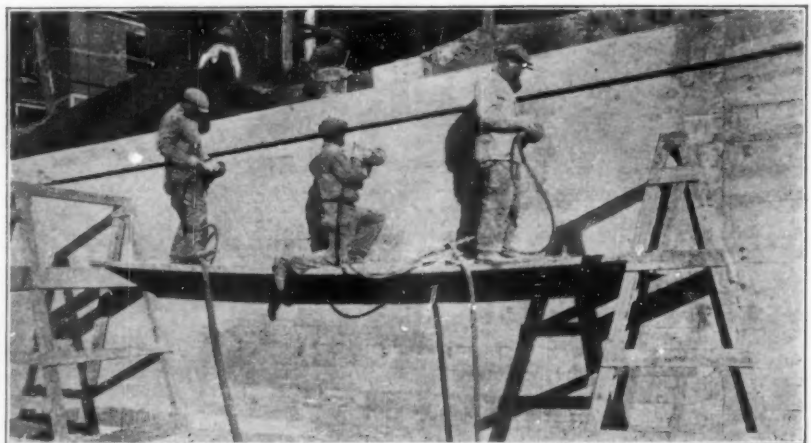
A visit to the station would be a somewhat uncanny experience for a layman. He would see machines starting and stopping, switch breakers going on and off, and all without a sign of an operator, as though some mysterious being were in control of the place.

The mysterious being would be the operator in the other station more than three miles away. He would be controlling the station through impulses sent over telephone wires leased from the New York Telephone Company. The pressing of a key only once automatically flashes over the wire a telegraphic code composed of 25 dots and dashes. If anything prevents the switches functioning when the operator presses a key, the impulses continue to go over the wire until the service is performed. Each key has its own arrangement of dots and dashes, or code, which controls a particular piece of apparatus.

The flash of a signal light tells the operator when a switch has operated. He can also press keys to ascertain whether the various feeders are alive and operating properly. Another key will cause meters to record for the operator the load carried by the feeders, and also their voltage. If any of the transformer banks should overheat, a lamp will flash and a bell will ring.

#### Two Colts Foaled by Old Mare Mule

**O**LD BECK is only an ancient Texas "cotton mule" mare who has been on this planet long enough to vote, but she has done her bit toward breaking the age-old reproach of sterility leveled at her hybrid race. For she not only has borne offspring—two lusty colts—but now



Portable concrete-surfacing machines, run by compressed air, for use on either green or old concrete. Each machine weighs 13 pounds and can be handled in any position. The rotating cutter wheel is equipped with a flexible joint to insure an even action and to prevent marring of the surface

Company and adapted for The New York Edison Company by the latter company's engineers. The first supervisory control system of the Westinghouse Electric and Manufacturing Company was put in successful operation in 1921.

The new station is a brick structure

has a grandchild. For a mule to have a foal is an almost miraculous rarity, but for one of these to propagate is practically unheard of.

Yet this is the record of Old Beck, as detailed in the forthcoming issue of the *Journal of Heredity* by A. H. Groth of

Texas A. and M. College. Her first offspring was a daughter, sired by a jack, and foaled in 1920. This feat brought her to the attention of the college authorities, and she was soon given a home on the campus. Subsequent matings with other jacks failed to produce another colt, but a noted stallion of the college stud sired a foal that has grown up to look quite like a horse—and a fine horse at that.

Old Beck's mule daughter has remained without issue, in spite of several attempts to breed her, but the horse-like colt, a stallion, has sired one healthy colt, now over a year old.

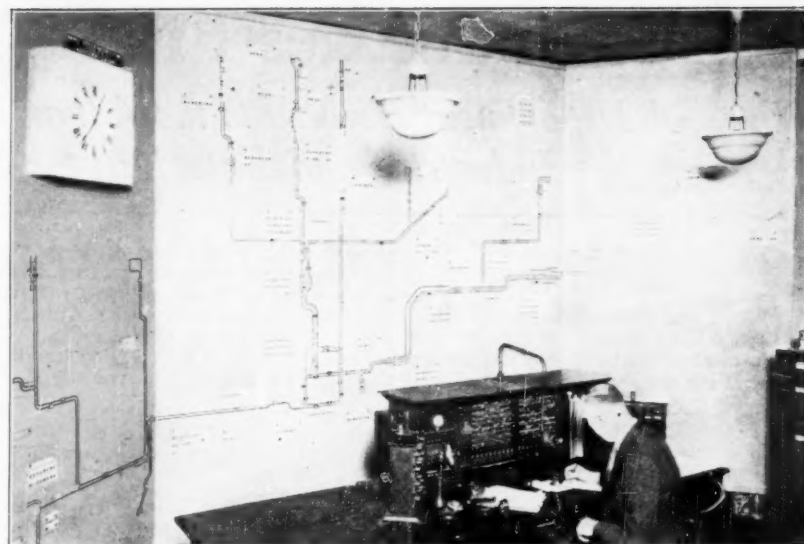
Mr. Groth says of him, "He has developed into a nicely balanced horse of saddle type . . . He performs well under saddle and is possessed of remarkable intelligence. The only mule characteristic which he shows is his dislike for crossing a ditch or stream."

In the same issue of the *Journal of Heredity*, Erasmus Haworth of Lawrence, Kansas, records another case of a mule mare producing a foal sired by a jack. The same mule is now believed to be with foal a second time.—*Science Service*.

### Diamonds Used for Cutting Metal

**T**OOLS pointed with diamonds have been used for years to dress grinding-wheels and to do cutting work in hardened steel and other materials that are too hard to be cut by steel tools. It seems to be a more recent discovery that they can be used economically in machining a number of softer materials, particularly those on which steel tools do not have satisfactory life, says a recent issue of the *S.A.E. Journal*.

Among the materials most commonly considered for machining with diamond tools are hard rubber, vulcanized fiber, ebonite, vulcanite, mica, "felt" paper-rolls, bronze, bearing metal, aluminum, copper,



Indicator board consisting of red and green lights and lines to indicate electric power lines as used in Chicago to check power consumption of railways

under certain conditions. For the automotive industry, it is probable that most of the interest in the application of diamond tools will be centered on their use in turning bronze and other bearing metals, aluminum alloy, copper, and Monel metal, at least for the present.

The tool can be run at such high speed that it is practical to take a very fine cut; this, with a marked freedom from tearing effect, making possible a smoothness of finish that can be obtained with no other known method of machining.

In turning aluminum, copper, and malleable iron, the diamond tool does not tear the metal and leave it rough, as does a steel tool. To make the most of its ability to give a smooth finish, the feed of the tools should be small, and very high speed

often, also, as black diamonds. Because of the absence of cleavage planes, carbons are less liable than borts to fracture and are said by some to be more desirable for the making of diamond bits for core-drilling in rock, the modern method of prospecting.

### Visual Key to Power Used

**T**HE part that electric railway service plays in the life of a large city is well illustrated by the diagram in a "loop" office building in Chicago. This diagram is dotted with many red and green lights; colored strips show the power lines and blocks represent the 35 sources of power. An inspection of this diagram will reveal the condition of the sources, whether idle or operating, and the sets of tracks that are energized by them.

The office instruments are connected to two automatic sub-stations several miles away. These instruments are so sensitive that at certain times of the day it is possible to determine just what moment a North Shore train from Milwaukee enters the system at Niles Center. From this master office, traffic could be tied up all over the unified system.

### Tiny Seed Produces Enormous Tree

**T**HE kernel of the seed of a *Sequoia gigantea* or California Big Tree is less than a quarter of an inch in length and is only as thick as a medium cambric needle. Yet from this infinitesimal germ may grow a tree that, like "General Sherman" in the Sequoia National Park, weighs over 6000 tons.—*Science Service*.

### Unloading Railroad Gondolas With Portable Device

**A** NEW portable conveying device can be used to unload easily any type of material which is ordinarily carried in hopper-bottom railroad cars. The unloading of such materials as sand, gravel, coal, coke, and crushed stone has always been expensive, as far as labor and time are concerned.

The unloader operates on top of the rail, (Please turn to page 563)



Portable unloader for railroad gondolas. As the material falls from the hopper of the car, a wide rubber-covered belt carries it to a storage point

Monel metal, and malleable iron. All these materials are more severe in their effects upon steel turning tools than their hardness and tenacity seem to indicate, or it is difficult to finish them smoothly with a steel tool.

It is said that economical results are obtained also in turning cast iron, at least

can be attained without damage to the tool or to the work.

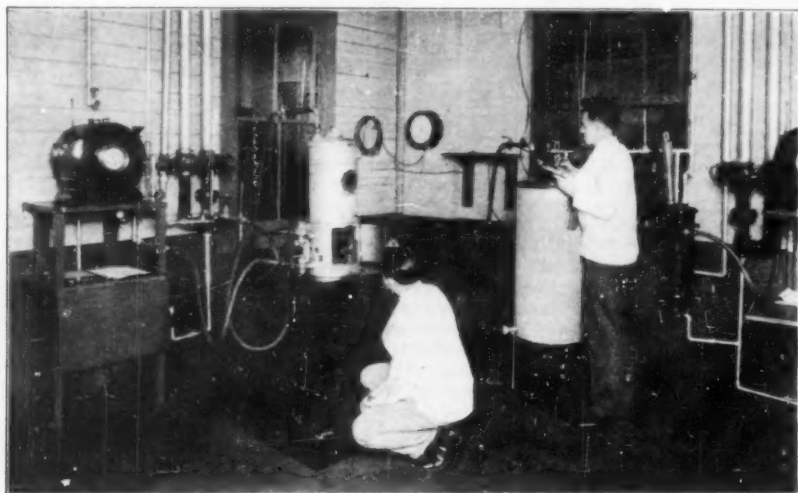
Two types of diamond are used for tool points. One form, which comes from Brazil, is a conglomeration of microscopic crystals. Most of these stones are black, but some are dark green, brown or yellow. The black stones are known as carbon, and

# Industries From Atoms

*A Department Devoted to the Advancements Made in Industrial and Experimental Chemistry*

## Research Extends Application of Gas Fuel

WHEN the electric light began to displace illumination by gas, the general public was inclined to foresee diminishing profits in the sale and manufacture of gas.



A view in the testing laboratories of the American Gas Association, where research work on the heating values of different grades of gas is carried on

While everyone realizes vaguely that the gas companies have continued to grow, the extent of their expansion is not generally appreciated. Industrial uses for gas have been developed to such an extent that they constitute a major outlet for the gas manufacturer. Because of its convenience, complete combustion, absence of ash, and the readiness with which it is regulated, gas is claimed to be "the ideal fuel" and because from the economic standpoint, the production of gas and by-products from bituminous coal is a much sounder proposition than direct burning of that coal, chemical engineers look forward to an ever growing use of gas both for industrial and domestic heating and refrigerating purposes.

The efficiency of the modern gas plant in producing gas from coal and oil is about 75 percent as compared with an efficiency of 20 percent in the modern electric plant. When all factors of investment, distribution, and efficiency of consuming apparatus are considered, it is claimed that gas produces more energy than an equivalent amount of electricity. These figures were presented to the Michigan Gas Association Convention by Walter C. Beckjord. The speaker pointed out that research into methods of distributing and utilizing gas would eventually result in a gas industry of proportions undreamed of at the present time.

Among the research problems being attacked by the gas industry is a study of gas-making qualities of American coals which involves a study of the by-products as well. This work should enable the gas industry to select the proper coal for any

given location to the best economic advantage. Other work centers around the details of the distributing system, such as proper pipe joints, high-pressure distribution, improved gas holders, et cetera.

Considerable work is also being done by the Bureau of Standards on the subject of

or longer exposures cause extensive attack and even complete perforation of the nasal septum. This is painless, however, and the operator may be entirely unaware of the perforation.

While, therefore, there is a real hazard in chromium plating, it is not critical and can be entirely eliminated by suitable measures. These should include an effective system of ventilation, wearing rubber gloves, aprons, and shoes, and prompt treatment of cuts and abrasions on the skin of workers.

## Ozone Increases Cotton Tensile Strength

TENSILE strength of cotton textiles is surprisingly increased by exposure of such fabrics to ozone at a baking temperature, according to P. B. Cochran and H. J. Graham of the Westinghouse research staff. A concentration of 0.5 percent ozone will cause a 20 percent increase in half an hour at 110 degrees Centigrade, (230 degrees Fahrenheit). Acceleration may be obtained by increasing either the ozone concentration or the baking heat; or a concentration as low as 0.1 percent may be used if the temperature be raised to 150 Centigrade. A tensile increase of 25 percent was noted for cotton twine. It is believed that the process might be economically feasible for improving the tensile strength of many cotton textiles.

## Fumes Produced in Blasting

DYNAMITE used in underground blasting must produce the least possible amount of poisonous fumes in order that the hazard of asphyxiating workers at the tunnel face may be reduced to a minimum. In an investigation being conducted by the Pittsburgh Experiment Station of the United States Bureau of Mines, in cooperation with the Hercules Powder Com-

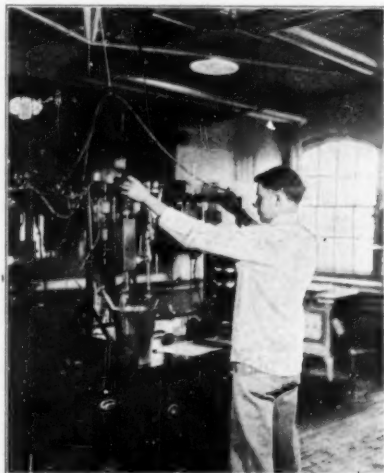
pipe corrosion, which constitutes an important item in gas plant maintenance. If oxygen could be produced cheaply enough (three dollars to five dollars per ton) it is believed that the oxygen could be used in water-gas production to make the operation continuous instead of intermittent.

## Health Hazard in Chromium Plating

WITH chromium plating flashing on the radiators of many modern automobiles, invading the bathroom on plumbing fixtures, and otherwise becoming generally familiar to everyone, the recent report on the health hazard in chromium plating by J. J. Bloomfield and W. Blum before the American Chemical Society is of timely interest.

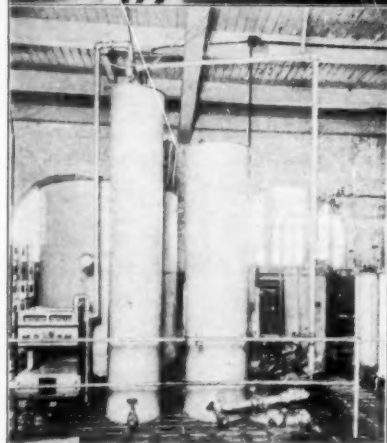
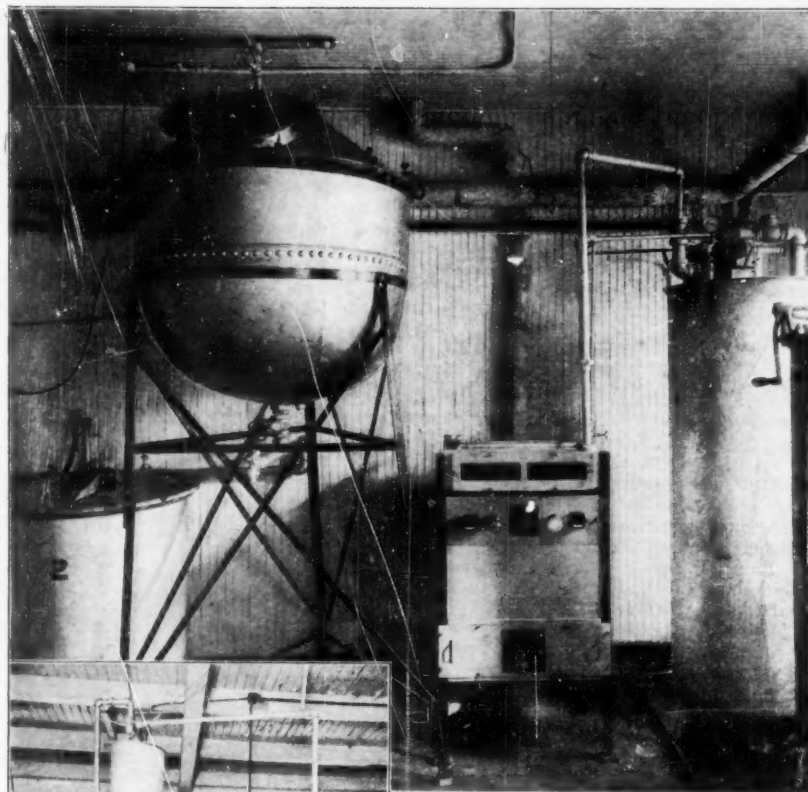
The bath used for chromium plating consists principally of chromic acid. During the plating process considerable hydrogen and oxygen are liberated, and these carry a spray of chromic acid into the air. It has long been known that in the manufacture of chromic acid and chromates the operators are subject to attack and perforation of the nasal septum. Formation of ulcers or "chrome holes" upon the hands or other exposed parts of the body often results.

It was found that exposure to very low concentrations of chromic acid—for example, one milligram in ten cubic meters, or one-sixteenth of a grain in 350 cubic feet (which is about the volume of air breathed by a worker in eight hours)—is sufficient to cause nosebleed and nasal inflammation in a week or less. Higher concentrations



Iodine pentoxide apparatus for determining completeness of combustion, built by Bureau of Standards for American Gas Association





Above and at the left are views of apparatus used for generating ozone and applying it to water for purposes of purification. See below

ignorance. In medicine, conditions are little better.

Mr. James predicts that a balanced ration will be worked out for every table and that similar scientific advances will take place in the field of medicine. He believes that the Germans will make the greatest contributions to these fields because they are constantly faced by the problem of "Where and how are we going to get enough food?"

#### New Apparatus Uses Ozone to Purify Water

ORDINARY city water is, of course, supposed to be potable, which means that it is free from *B. coli* and dangerous bacteria, although the bacteria count may be as high as 1000 per cubic centimeter. Treatment with ozone is said to eliminate practically all bacteria. Usually the only ones to be found are a few of the more hardy spores which are not at all dangerous, such as the hay bacilli. In addition to this, ozone treatment will remove any foreign tastes or odors such as that contributed by chlorine and will also oxidize a high percentage of any organic matter which may be carried in solution in the water. This organic matter is picked up, from leaf mold and other discoloration, as the water travels through the earth. The treatment with ozone delivers a water of crystal clearness free from bacteria and with a very low organic content.

There are many methods of producing ozone, but only a few have any commercial value. Competent authorities agree that the most practical means for ozone produc-

tion is from the action of an electric brush discharge which occurs when a current is passing between two electrodes through an air gap and a solid dielectric. The brush discharge is characterized by its peculiar noise, its blue-violet color, its gentle flow, the production of the so-called electric wind, and above all by its remarkable property of converting oxygen into ozone.

The apparatus illustrated uses this method of producing this extremely active gas which is then bubbled through a column of the water to be treated. The same apparatus has been adapted to the purification and deodorization of air and for the purification of water in swimming pools. Manufacturers of bottled beverages are turning to this method of insuring the purity of the water they use.

#### Rubber-Cellulose Combination Used for Coated Fabrics

INTEREST in the reference made in these columns a few months ago to a new material produced by a combination of rubber and celluloid prompts the publication of this formula that is in commercial use for making a waterproof coating for fabrics used in the raincoat trade.

##### Dope Solution

	Weight Percent
Cotton Wet.....	12
Benzol.....	53
Hexalin acetate.....	35
	100

##### Rubber Solution

Raw rubber.....	8
Hexalin acetate.....	37 1/2
Benzol.....	54 1/2
	100

##### Pigment Mixture

Pigment.....	50
Castor Oil.....	50
	100

The spread coating is made with the following combination:

	Parts
Dope solution.....	25
Rubber solution.....	15
Raw castor oil.....	8
Pigment mixture.....	5
	53

This product when applied to cotton produces a fabric which is extremely flexible, very smooth, and absolutely waterproof.

The term "cotton wet" used to designate one of the ingredients in the dope solution is not a rubber one but is fairly common in the lacquer industry. It signifies nitrocellulose in a solution of 30 percent by weight of denatured alcohol. The product is handled commercially in this form because of a ruling of the Interstate Commerce Commission.

#### Wood Preservatives Prove Effective in 15-Year Test

WOOD preservatives are generally known to add remarkably to the life of timbers exposed to the elements, but it is not often that quantitative data on their effectiveness becomes available because such tests must of necessity extend over a long period of years to be conclusive. Hence, the careful experimentation reported in *Wood Preserving News* by the

(Please turn to page 558)

#### Claims "When Do We Eat" is Strongest Urge to Research

THE great inventions in the near future will be in food and medicine, predicts Christopher James, in *Advertising and Selling*. Mankind has pretty well caught up with its needs in transportation and communication, but people are still abominably fed, and the victims of fads and

# Learning to Use Our Wings

*This Department Will Keep Our Readers Informed of the Latest Facts About Airplanes and Airships*

CONDUCTED BY ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York City

## Aviation Safety Congress

THE Daniel Guggenheim Fund for the Protection of Aeronautics has, since its inception, made safety in aviation the object of its main efforts. Recently the Fund organized a Congress on Safety in Aviation, arranged in co-operation with the National Safety Council, and held at the Hotel Pennsylvania in New York City. The program of the Congress is a proof of the fact that safety in flying is not a matter of one invention or method, but lies in the development of many divers aids. Thus the sessions of the Congress dealt with Structures and Materials in Relation to Aviation Safety; Airports and Airways; Aids to Navigation; Medical Aspects; Aerodynamics; Power Plants; Operation of Aircraft in Air Transport; Weather Service; The Public and Flying; and last but not least, Fire Prevention.

The sessions were attended largely by technical men, but the lay public was also well represented. In several of the sessions, members of the public would rise to ask how safe aviation really is.

Perhaps the best answer made to this question was that of Senator Hiram Bingham, the new president of the National Aeronautic Association. The Senator, who occupied an important position with the Army Air Service during the World War, and has since been a potent factor in aeronautical legislation, said that we could have any kind of safety that we wanted, just as we could have any kind of safety in going by water around Cape Cod. In a row boat, there would be considerable danger. A fishing sloop would be far from safe. An ocean liner would be perfectly safe. So in aviation, we could range from great hazard in the flying of unlicensed craft, manned by inexperienced personnel, to the safety approaching that of a railroad on the regular passenger lines operated by the great air transport companies.

The Congress achieved a great success in bringing the exact elements of aviation safety before the public and in placing

squarely before the technicians the present status and the future needs of safe flying.

## Experiments in Fog Flying

FOG flying attracted due consideration at the Aviation Safety Congress. The Fund has made the conquest of fog one of its major projects. Lieutenant James H. Doolittle, of the Army Air Corps, one of the most experienced test and research pilots in the country, and winner of the Schneider Seaplane Cup in 1925, has been secured by the Fund for a series of systematic experiments in fog flying. A special plane with dual control will be placed at his disposal as well as every possible instrument or device likely to be of service in blind flying. The action of such devices will be tried out in fair weather, with one pilot closed in his cockpit. The "blind" pilot will attempt first to fly by instruments alone, then to land "blind" by the aid of special height indicators, based on electrical and acoustic principles. The experiments will then be repeated in an actual fog, under flying conditions. This work will certainly test even Doolittle's iron nerves.

## Altitude Flights

OUR photograph shows E. T. Allen, test pilot for the Boeing Company of Seattle, Washington, clad in leather and fur, with face mask, goggles, and oxygen tube glued to his lips, just as he would appear at an altitude of 30,000 feet or so above the ground.

In military or naval aviation, altitude gives the flier a great advantage. At very great heights, he is safe from observation and from anti-aircraft guns. Swooping down from altitude on an enemy pilot flying in a lower zone is a formidable maneuver.

The single seater pursuit built by the Boeing Company, not only attains a height of 30,000 feet, but it can fly at 180 miles per hour with full military equipment. The new pursuit ship has excellent lines and is

very "clean." After tests it is to be turned over to the Navy Department.

## Accident Causes

IT is interesting to read the classification of aviation hazards presented by Mr. Ted Wright, Chief Engineer of the Curtiss Company. Twenty percent of all accidents are caused by forced landings due to engine failure. This classification includes engine failures caused by breakage or non-func-



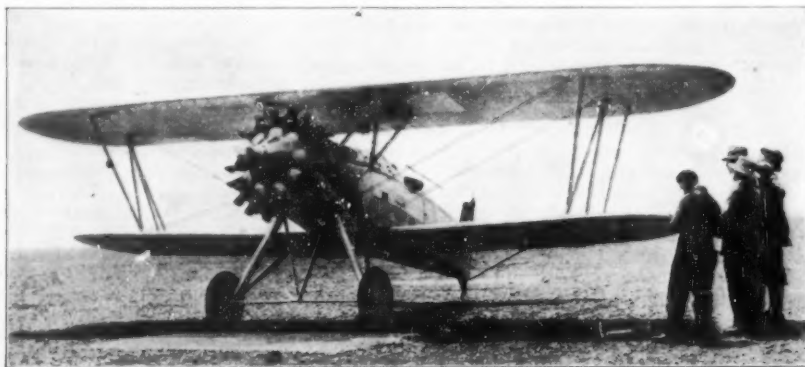
E. T. Allen, test pilot for the Boeing Company, as he appears at an altitude of 30,000 feet, equipped with apparatus for breathing oxygen

tioning of the engine proper, or of the auxiliary systems such as fuel, ignition, cooling, or carburation. Approximately the same percentage of failures occurs in each of the above sub-items.

Mr. Wright advocated as remedies the use of multi-engined airplanes, capable of flying with one or more power units disabled; provision of a more dependable power plant; and provision of more landing fields throughout the country.

Errors of judgment by the pilot are responsible for 53 percent of accidents. We believe that this estimate is far too high. It is sometimes very difficult to determine the causes of an accident. There is a temptation for investigating boards to blame the pilot, particularly when the pilot is dead and not able to defend his reputation. The accident may really have been due to instability, insufficient control, too high a landing speed or other deficiency in design.

It may be argued that the pilot should



Because of the value of altitude in military and naval flying, experiments are being carried out with this Boeing plane, capable of reaching 30,000 feet

realize these deficiencies and fly his ship so as to take account of them. That is asking perhaps too much from even skilled flyers. The remedy lies partly in better training, partly in better design of our airplanes.

Weather conditions were estimated by Mr. Wright as being responsible for 19 percent of all accidents. These include chiefly accidents due to severe storms, lightning, fog, ice formation, et cetera. More meteorological stations and better

the ship can be turned completely around in a space no wider than a city street, or held almost stationary in the air.

The airship has always been regarded as a naval or military weapon and as a medium of long distance transportation. It has never been considered as of possible usefulness in aerial service, while the airplane has been put to work in dozens of industrial applications. The Meadowcraft airship with its small size and extreme maneuver-

the Wasp engine actually turns up more revolutions with the muffler than without it.

### Runways for Airports

THERE is now a special publication devoted to the construction and operation of airports and appropriately termed *Airports*. A most interesting series of articles starting in a recent number is that dealing with runways.

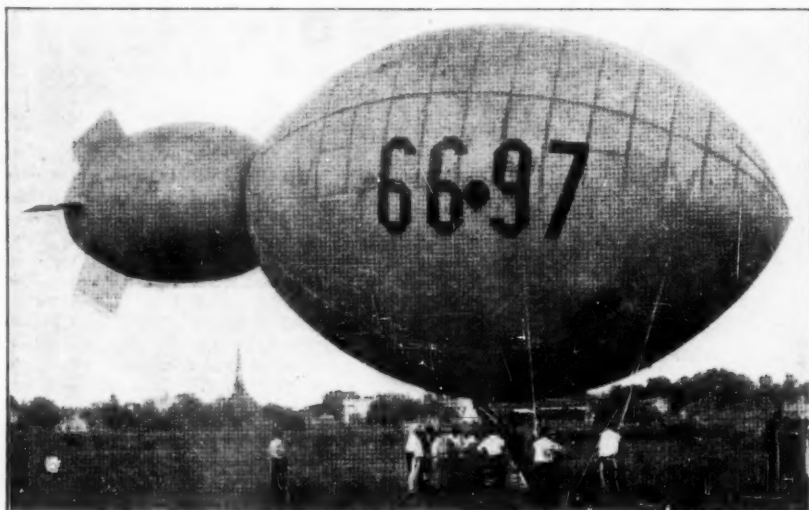
Where the soil is such that dry weather does not make it dusty, if there is sufficient drainage to keep it from getting muddy or wet, and until the traffic gets heavy, the natural soil scraped clear of vegetation serves all purposes. But where these desirable conditions are not available and air traffic is heavy, artificial runways become necessary. Asphalt, brick and concrete each have their advocates. For each of these, firmness and uniformity, smoothness, good visibility, and durability are claimed. Experience alone will decide their relative merits. In the meantime, civil and highway engineers and manufacturers of these three materials will have many arguments about their respective merits.

### A Rubber-Hydraulic Landing Gear

THE design of an airplane landing gear is quite a difficult matter. An axle between the two landing wheels may get caught by an obstacle on rough ground and tend to nose the airplane over. Therefore, the transverse axle has disappeared in most modern designs. It has evolved to a short, stub-like affair to the end of which are connected three struts, as shown in our photograph of the Stearman landing gear.

The landing loads may come on the chassis from any direction. There is always a vertical load as the wings lose lift and the plane settles on the ground. There may be a side load, if the landing is made with one wheel lower than the other, or if there is a side wind. There may be a force in a backward direction if the plane meets an obstacle of any kind on the ground. The struts, therefore, are so arranged that they can take loads in any direction.

In the Stearman landing gear, the two inclined struts are hinged at the center of the fuselage, and take up the side and backward loads. The outer strut is a shock absorbing member which compresses through



What is said to be the world's smallest airship has a strange resemblance to a misshapen potato. It has a lifting-gas capacity of only 22,000 cubic feet

weather service, particularly by the use of radio communication, will do much to remove these hazards.

Finally, 8 percent of accidents are due to structural failure. The structural design of the airplane is very advanced, which accounts for the low percentage. The worst of structural failures is that they are apt to involve fatal results, and also that they cause the greatest blow to morale. Accidents due to weather are taken somewhat for granted in all human activities. There is, on the other hand, something particularly disquieting in the report of a fatal accident due to the loosening of a wing in the air. The remedy here is in still more careful structural analysis of the airplane, in rigid inspection during manufacture, and in better maintenance.

While Mr. Wright's paper dealt especially with structural analysis and design, it really gave a bird's eye view of the entire problem of aircraft safety, and was all the more valuable on that account.

### World's Smallest Airship

THE Meadowcraft Balloon and Airship Company have recently built what is the smallest airship of to-day. It is 65 feet long and 30 feet in diameter, and has a gas capacity of only 22,000 cubic feet. With a 22 horsepower Henderson motorcycle engine it attained a speed of 20 miles per hour. It has a weight empty of 800 pounds and can carry 500 pounds of useful load.

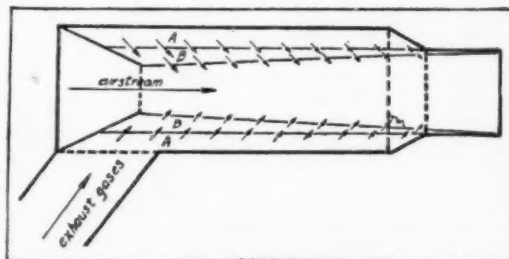
The airship is non-rigid of course, and consists of two lobes. The front lobe is the main lifting unit; the rear lobe is jointed and serves to give both directional and horizontal control. This is an entirely novel idea, and the control obtained is very powerful; according to *Air Travel News*,

ability has possibilities for such work as aerial advertising, aerial photography and insect control. With its ability to hover over one spot, it has, for certain phases of such work, an obvious superiority over the airplane. Its employment for such purposes may mark a new phase of airship utility.

### A New Type of Silencer

THE new Loening cabin amphibian, Wasp engine powered, is a remarkable plane, whose many excellent features we hope to describe in detail at a later date. The muffler is particularly interesting. It consists of three concentric cylinders, the

Right: Diagrammatic sketch of new exhaust silencer. The exhaust gasses enter at one side, and are caused to swirl as they expand and pass from chamber A to B, and then into the air stream and the outer air, with little noise



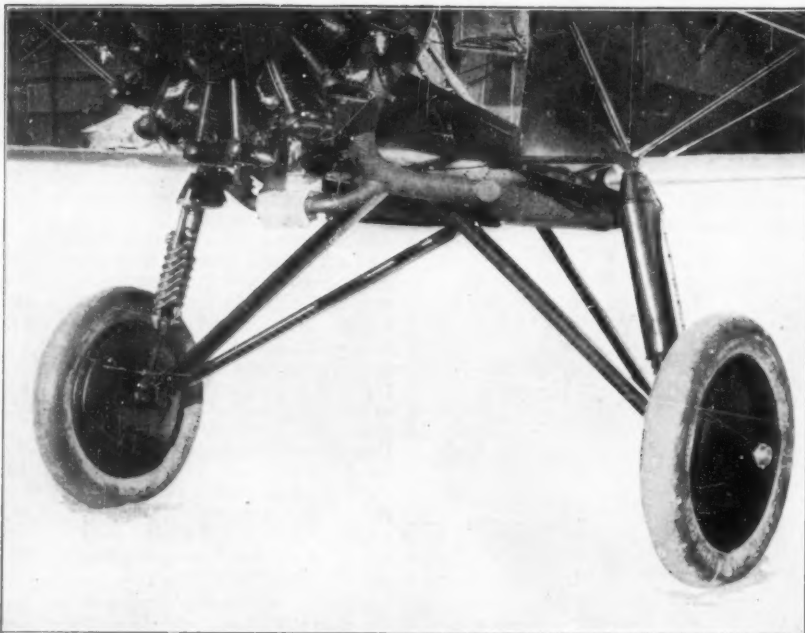
inner two perforated. The exhaust gases enter on one side, and therefore whirl as they expand. The innermost cylinder consists of two truncated cones, producing a Venturi effect.

The gases pass from the chamber between the outer two cylinders to the one between the inner two cylinders and then inside the inner cylinder. In the process the flame and noise of the exhaust is reduced. At the same time the Venturi effect gives suction instead of the back pressure which is customary with mufflers. As a result

several inches so as to lessen the shock. A study of the photograph will show that the wheels will swing up and out as the compression strut is shortened. The design of these compression struts has passed through many stages of evolution, and they are now generally a combination of a hydraulic system and a spring or rubber system.

For a given weight, rubber is the material which will take up the greatest energy of shock. It is so elastic that it has far better shock absorbing properties than the best of steel springs. Up to two or three years





The new Stearman landing gear, in which the shock is taken up by a combination hydraulic and rubber shock-absorbing system. See text in these columns

ago, rubber was used as the sole shock absorbing element. The rubber, in the form of cord or disks, took up the initial shock admirably. Unfortunately, the energy stored in the rubber is only partially destroyed during its absorption; therefore after a severe landing the airplane tends to rebound. Hydraulic shock absorption does away with this rebounding tendency.

In the Stearman "rubber-draulic" gear, the hydraulic unit consists of a piston with a small orifice operating in a cylinder full of oil. As the strut compresses and the piston travels upwards in the cylinder, the oil is forced through the narrow orifice, energy is dissipated thereby, and converted into heat without the possibility of reconversion into energy of rebound.

After the landing shock has been absorbed by the hydraulic system, taxiing loads are taken up by rubber shock absorber cord in tension. This cord is a continuous piece wound around a series of pins welded to the frame of the gear, and extended as one part of the compression strut. The part fixed to the wheel moves upward relatively to the part which is fixed to the rest of the airplane. The greater the travel in compression, the less the load actually transmitted to the fuselage of the airplane, and in this particular gear the total travel is eight inches, of which six inches is taken by the hydraulic portion. An average grade of lubricating oil is used in the cylinder, but in winter a zero oil is employed.

#### Aerology at the Airport

NOTHING is more important for air transport operation than efficient weather service for the pilot. We are glad to see therefore how seriously the matter is treated at the Brook Park Airport, of Cleveland, Ohio. One of our photographs shows L. E. Pierce, in charge of the aerological office at this airport, on top of one of the hangars, about to launch a meteorological balloon. This is similar in appearance to a toy balloon, but larger, inflated with hydrogen, and far more buoyant. Such

a balloon when properly inflated will rise at a predetermined rate, which is 550 feet a minute as a rule.

With a telescope and sextant, Pierce observes the course of the balloon in flight and by plotting its course in all three dimensions, can determine both the velocity and direction of the wind at various altitudes. Temperature, barometric pressure, condition of weather, ceiling, and visibility are other meteorological data recorded at frequent intervals at this and other stations. The data from all stations along a given route are recorded on a large board in the hangar and serve to give a pilot invaluable information before his flight.

#### The Goodyear "Puritan"

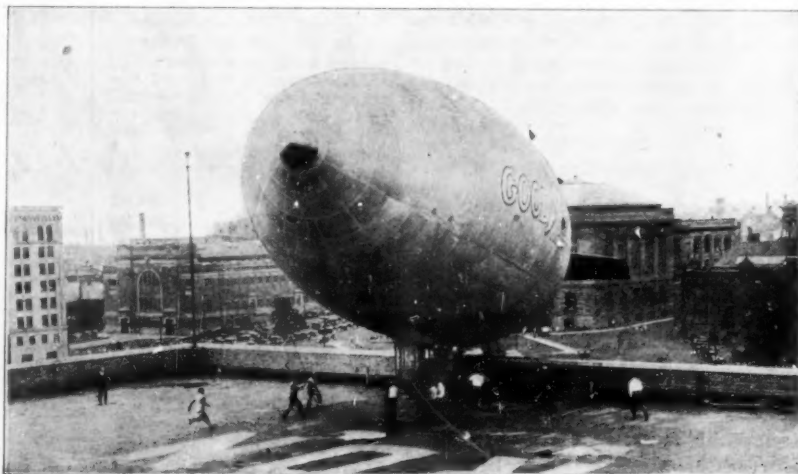
IT is possible that small airships will really be the first air-borne craft to land consistently and in safety on the roofs of our cities, a feat recently accomplished by the Goodyear *Pilgrim*. A sister ship of the *Pilgrim*, the Goodyear *Puritan*, has a gas capacity of 86,000 cubic feet of helium, and is powered with two Ryan-Siemens five-cylinder radial engines, which can drive the ship at a maximum speed of 55 miles per hour. The engines are mounted on outriggers, so that the cabin is insulated as much as possible from their noise and vibration. The framework of the car and keel are built of duralumin girders, almost exactly like those to be incorporated in the 6,000,000 cubic foot airships now on order. The passenger cabin is built of sheet duralumin over the girder framework, and is shaped very much like a flat iron. The keel is contained inside the envelope, making the cabin an integral part of the bag.

Non-rigid airships used to have their cars suspended by a net work of cables which increased head resistance. This is avoided in semi-rigid airships, and we believe that the *Puritan* really belongs to the class of semi-rigid airships. One of the innovations in design is a single landing wheel projecting below the center of the cabin. This wheel, mounted on a duralumin frame, acts as a support for the ship when it is on the ground, and permits easy rolling from one place to another. Because the airship is lighter-than-air, the wheel receives very little load on the ground.

(Please turn to page 556)



Releasing a sounding balloon



The Goodyear *Pilgrim*, sister ship to the *Puritan* described above, has a gas capacity of 86,000 cubic feet and is powered with two five-cylinder engines

# Industry after industry discovering new uses for this grainless wood board

*Read the story of its wide and steadily increasing uses. Read about its remarkable workability, uniform strength, high resistance to moisture, and many other advantages. Then send for large, free sample of Masonite Presdwood, and put it to the test yourself.*



FOR STORE FIXTURES

Here is a product which is writing a new page of progress, and in scores of industries meeting challenge after challenge of modern manufacturing.

Think of it!—genuine wood board that is absolutely grainless! A board that will not crack, check, split or splinter! A board of uniform strength and truly remarkable workability!

And yet these are only a few of many advantages of Masonite Presdwood. It is very dense and tough. It cannot be destroyed by moisture. One face is steel furniture finish for smoothness and the other side has an imitation canvas finish. It requires no paint for protection, and also takes any finish beautifully.

Presdwood is simply wood torn apart, and put together again. It contains no foreign substances of any kind; not even a chemical binder. So it cannot damage tools.

Presdwood comes trimmed to a four-foot by twelve-foot size. It can be used on any wood-working machine; saw, planer, sander, shaper. It can be cut out, punched, die cut and shaped. In fact, you will find that Presdwood is adaptable and workable almost beyond belief.

## No limit to its uses

There seems to be practically no limit to the uses for Masonite Presdwood, and new uses are being discovered week after week.

Candy manufacturers are now using Presdwood for starch trays, and in a number of large manu-

facturing plants all the telephone booths are lined with it.

In the Chicago Art Institute it is backing and permanently protecting rare works of art.

The ceilings in the new Pullman Cars of various railroads are made of Presdwood; so is flooring for dance halls and pavilions.

Packing cases, concrete forms, radio cabinets, incubators and bowling alleys—these too, are being made of Masonite Presdwood.

And store fixtures of all kinds, bedroom screens, invalid trays, shelving, work-bench tops, table tops, clothes hampers, bread boxes, cupboards, breakfast nooks and china closets!

Campers' tables, automobile bodies, safety wheels for bathing beaches, speed boats, highway signs and entrance signs, all these too, are made of Presdwood!

## Send for free sample

Write for a large, free sample of Masonite Presdwood, and find out what it will do for you. It may be the very material for which you have long been looking. It may enable you to make a worthwhile improvement in your product, and at the same time lower your operating costs to a marked degree. Try Presdwood for yourself!

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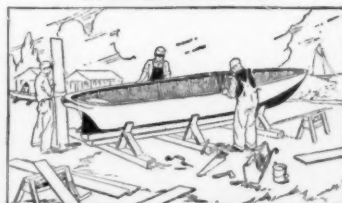


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IN BUILDING BOATS



# Strays From the Ether

## A Monthly Review of the Progress Made In All Branches of Radio Communication

### Television Abroad

*AS* noted in our November issue, Albert G. Ingalls, Associate Editor of the SCIENTIFIC AMERICAN, is traveling in Europe at the present time, collecting material on various scientific subjects, and arranging for articles that will appear in future issues. The following information on television as developed in England was rushed to us just in time for publication in this issue. As



The Baird television transmitter as used on board ship for tests of transmission over distances

Mr. Ingalls witnessed demonstrations of the apparatus, he is qualified to give an authentic description of the results obtained.—The Editor.

**BAIRD**, the well-known British inventor, has successfully accomplished two new and interesting things. The first is color television. The second is stereoscopic television.

In addition to these, Baird has refined his system of ordinary monochrome television to the point where standard receiving apparatus in finished form, ready to use, may now be seen in the display windows of London department stores. These are not priced as low, it is true, as a simple radio set but, to give a rough comparison, they cost about the same price as a certain popular American make of motor car.

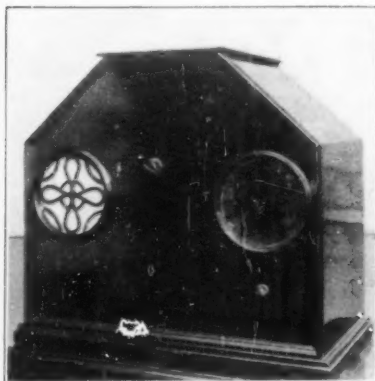
To find out what kind of television Baird is planning to serve up to the British people, I arranged for a demonstration of the exact type of apparatus described. At the transmitting end was a man. One could see and hear him. The man talked, chatted, sang a song, smiled, made some faces, stuck out his tongue and rolled his eyes. All this was clearly visible. As the expression "clearly visible" is some-

what indefinite, it could be said that the man's facial details were easily distinguishable; a fair sized wart would, for example, be discoverable if present.

Baird's television does not appear in the orange-red tone of the ordinary neon tube; it gives the impression of being more like black and white, although close scrutiny shows that it is not just these. What kind of a tube does he employ? No facts were given out. Nor would the demonstrator open the cabinet. This is more or less in accord with a policy generally pursued in Europe—although slowly being modified—of keeping secret various methods of manufacture instead of frankly pooling the results of research as we do in America.

Baird's system of color television—"polychrome" television is the correct technical term—is intrinsically interesting. Whether it has a future or not is another speculation possibly best answered by inquiring whether polychrome moving pictures have a future.

The system is described in detail in Dinsdale's *Television* (Television Press, London, 1928) but is so simple that a few hints will suffice to describe it to those who have even a rough conception of the elementary principles of ordinary television. Instead of the single spiral of holes used with the ordinary disk, the



This commercial television receiver is now available, on order only, to devotees of the art in England

polychrome disk bears three spirals. Each spiral contains 36 holes. This is shown in the drawing. Each spiral corresponds to a different color; namely, green, blue, and red. These are the primary colors whose proper combinations make any desired color or tint. In the Baird apparatus they are used in sufficiently rapid succession to fool the eye. Thus the object or person being transmitted is scanned with a green spot of light, then a blue spot, then a red; and so on. The disk turns 10 revolutions per second.

The colors are obtained by means of ordinary colored light filters attached to the respective spirals, covering the holes.

In effect three separate pictures are transmitted, seriatim. The first contains nothing but the green parts, if any, of the subject; the second only the blue parts; the last the red parts.

The receiving apparatus is not quite so simple; Baird had difficulty obtaining the tubes which would emit light corresponding to the three primary colors. A neon tube provides the red; and the blue and the green are obtained respectively from one tube containing helium and mercury vapor. A commutator mounted on the armature shaft of the disk driving motor switches the neon (red) lamp when the red viewing holes of the receiving disk (which has the same trio of separate spirals as the transmitting disk) are in line with the viewer's eyes and the lamp. When the remaining two sets of holes, the blue and the green, have rotated into position, the helium-mercury lamp is switched on automatically.

Of course, the use of three colors involves, theoretically at least, a consideration of the necessity either of transmitting three times as many images per second or producing a flutter. However that may be, in practice the rate of transmission is not speeded up, yet there is no very noticeable flutter. The separate colors of various objects came through remarkably well in the demonstration at Glasgow. These were highly colored objects, it must be admitted, yet as the saying goes, "Give it a chance, it is only a youngster."

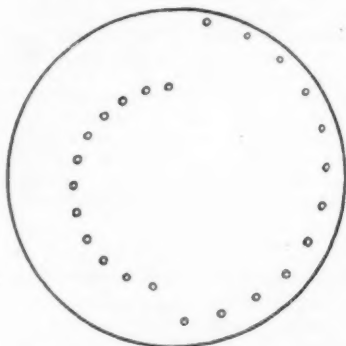
Another accomplished fact to Baird's credit is stereoscopic television. I was unable to see a demonstration of this because the apparatus was "on tour" in the Netherlands at the time of my visit. It is said that the televised objects stand out in three dimensions with complete illusion. The method of accomplishing this end is altogether simple in principle. The essence of it is that the object is scanned from two separate points of view.



The Baird stereoscopic television receiver. The "looker-in" is viewing image through a stereoscope



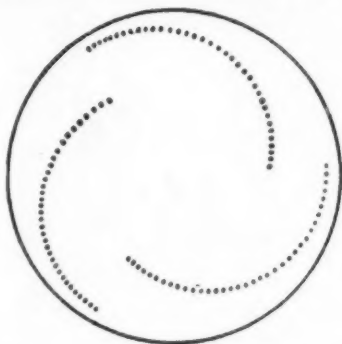
To permit this, the transmitting disk bears two spirals, one near the edge, the second nearer the center—to be exact, about  $4\frac{1}{2}$  inches apart. This is not very much more of a spread in point of view



A television disk for reception of monochromatic stereoscopic images

than that afforded by the two eyes of the average human being. It is assumed that the reader already understands the elementary principle of stereoscopic vision.

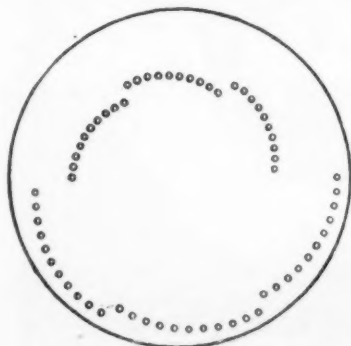
Baird has gone even further; by replacing each of the two spirals of the system described for stereoscopic television by a trio of double spirals (see sketch) he



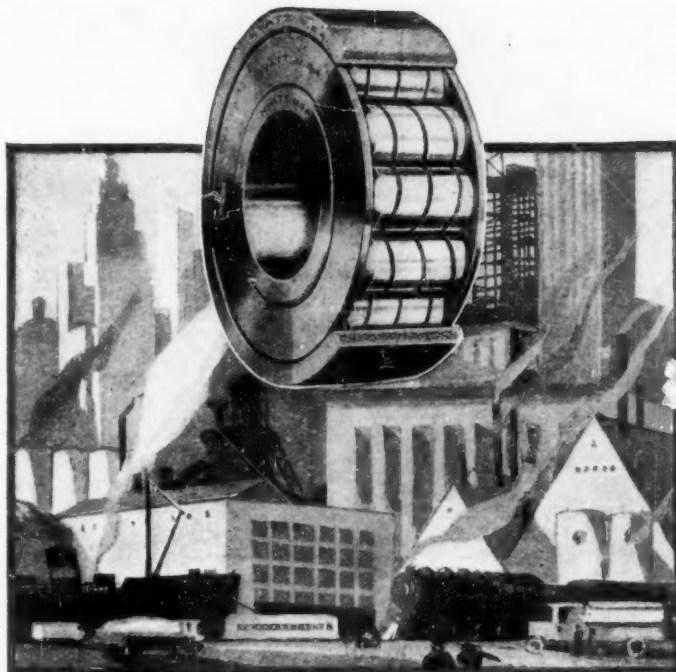
The three spirals on this disk allow reception of three-color images

has obtained successful stereoscopic color television.

Whether Baird's ordinary monochrome television is "better" than some of the American systems is a question which will occur first to many if not all. Admitting first that comparisons are odious, it is difficult to compare phenomena when months have intervened between seeing



Stereoscopic and color television is accomplished with this disk



## The Hyattway is the Saving Way . . .

**P**OWER saving—profit saving—longer life—faster production—these are the wonders Hyatt Roller Bearings are working in all industrial applications.

Wherever installed on wheels, drives, shafts, gears and motors, smooth running Hyatts transmit power without effort or waste. Practically frictionless they avoid the sticking and drag of plain bearing surfaces.

Equipment lasts longer when rugged Hyatts are employed. Immunity from bearing breakdowns insures faster, smoother production. Attention is confined to infrequent lubrications. Labor and maintenance costs are negligible.

Throughout all industrial applications as well as in railroad, automotive, mining and agricultural equipment engineers have found that the Hyatt-way is the Saving Way.

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# HYATT

## ROLLER BEARINGS

PRODUCT OF GENERAL MOTORS



This Brooklyn amateur, Nat Pomeranz, holder of call 2APD is credited with being the link between this country and Porto Rico during a recent storm which damaged the island. Pomeranz handled messages almost continuously for 48 hours, using both transmitter and receiver during this time

them. In general, the respective results seemed not so much better or poorer as quite different.

#### How to Powerize Your Receiver

**T**HE practical details of how to convert any receiver over to socket-power operation and super-power amplification—a process known as “Powerizing”—are now available in the folder just issued by the Radio Receptor Company, of 106 Seventh Avenue, New York City.

This booklet covers the requirements for every conceivable set, whether it employs 99 type or storage-battery type tubes, and whether it is totally or partially to be powerized. Thus for the receiver now entirely battery-operated, it is possible to employ a powerizer supplying the “A,” “B” and “C” requirements, as well as super-power amplification. For the receiver already provided with a “B”-eliminator, there is a powerizer which, in combination with A-C tubes and suitable harness adaptor, replaces the messy storage battery without rewiring the set.

For the receiver which must operate with 99 type tubes, there is a powerizer which supplies 3.3 volts for “A,” as well as “B” and “C” voltages, and furnishes super-power amplification. For the receiver with 99 type tubes, such as the Radiolas 25 and 28, there is a powerizer which connects the filaments in series and furnishes high-voltage current from the usual rectifier.

And for radio enthusiasts desiring power amplification of exceptional quality, there are amplifier-powerizers for the home as well as for the auditorium or outdoors. The folder is available for the asking at the address given.

#### Liquid-Filled Photo Cell

**A** TUBE which generates electrical energy when sun or other light falls upon it was announced recently by the

Radiovision Corporation, New York City. Engineers of the company believe that the tube may not only bring practical television much nearer, but that it may open up wide fields of experimentation hitherto unexplored.

According to Edgar H. Felix, vice-president of the company, the photo-voltaic cell generates one thousand times the current generated by the present-day photo-electric cell.

“The photo-voltaic cell is so sensitive that the wave of a hand over it causes its current to vary by a marked degree,” it is explained. “By the use of color filters any color may be made to cause an individual electrical response. This principle may some day be employed for burglar and fire

alarm purposes. The cell will lend itself to spectacular demonstrations, such as turning on the hot water heater, opening the furnace, closing windows at sunrise, and turning on lights when darkness falls, but its real value is in the line of scientific experimentation.

“The cell resembles a large radio vacuum tube filled with a greenish fluid. In it are two plates set in parallel. When properly coupled to a standard two-stage amplifier of a radio receiver, its current fluctuations, produced by turning on and off a 50-watt light, are sufficient to actuate a sensitive relay. Consequently, enough energy is available to control any electrical operation by means of light.

#### Esperanto As a Radio Language

**A** RECOMMENDATION that transmitting stations broadcast communications in the Esperanto language to as great an extent as possible was a feature of



Tiny fuses for use in radio sets are now available. They serve to protect various circuits. Made by Littlefuse Laboratories, 1772 Wil-son Avenue, Chicago, Illinois

a recent meeting of the International Broadcasting Union. A survey showed that 168 stations in Europe, Asia and the United States sent out messages in Esperanto, it



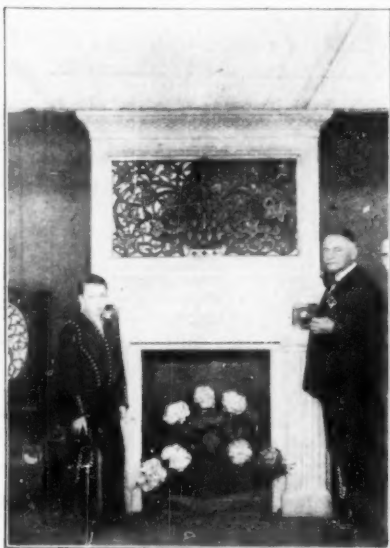
The art of the tea-taster has been modified and adapted to radio, and now we have the tone tester. The photograph shows Martin T. Olsen, of the Jensen Radio Manufacturing Company, and who in a recent test, it was reported, was able to distinguish between audible sounds over the entire musical range

was reported by the secretary. The station at Geneva makes weekly broadcasts in this language.

Various commissions pursued their study of the organization of relays for a wider exchange of radiophonic programs. It was decided to arrange relays between Germany, Austria, Poland and Czechoslovakia. Announcement was made that considerable technical progress has been achieved in relaying musical programs by employing submarine cables between Great Britain, Belgium and Germany.

#### Morocco Has Radio Beacon

SPAIN has established a radio beacon at Cape Tres Forcas, Morocco, the first to be placed on the coast of Africa, the United States Lighthouse Service announced recently. It is expected that another beacon will be installed at Cape Spartel, south



At a recent German radio exposition this huge loudspeaker was demonstrated. It is built into the mantelpiece above a fire place, and is ornamental as well as effective

of the entrance to the Mediterranean Sea.

The beacon at Cape Tres Forcas transmits the letters TF, followed by a long dash of four seconds' duration. The signal is transmitted by a continuous wave on the 300-kilocycle band.

#### Television Motor

FOR experimenting with television receivers, it is necessary that the motor employed for revolving the perforated disk be of such a type that its speed is continuously variable, and that there be no sparking anywhere in the machine.

Such a motor has recently been announced by the Interstate Electric Company of St. Louis, Missouri. The motor is made in two sizes, the six pole type for a speed range of 50 to 1100 revolutions per minute, and the four pole type being variable from 100 to 1700 revolutions per minute. There are no brushes, commutator, automatic switch or any other device that can spark. The shaft runs on ball bearings, insuring minimum friction and quiet running.

## Get rid of money worries for good!



TWO MEN were talking in a club-house reading room.

"Everything's going pretty well with me—now," said one of them. "I make enough money to pay the bills, enough even to take a vacation now and then. But I sometimes wonder how it would be if anything happened to me. I know perfectly well the house might be sold, my son taken out of school..."

The other man smiled.

"That's just the way I was fixed," he said. "And then a funny thing happened. I answered an advertisement and got hold of a copy of the Phoenix Mutual 'Prosperity Plan.' Maybe you've heard of it. I filled it out.

"I was paying 6% interest on my mortgage at the time. The Phoenix people showed me how by paying only about 1½% more I could fix it so the bank would hand the home over to my wife clear of debt. That was the end of that worry.

"Then they made a special arrangement that will put Jimmie through college. That fixed that. And just recently they fixed up what they call an 'income agreement'—and now the family will have an income of \$100 a month after I'm gone.

"So the only things I had been worrying about are taken care of—and all because I filled out that little piece of paper!"

WOULDN'T you like to make your life plan financially foolproof? Wouldn't you like to get rid of money worries for good?

You can. The coupon at the bottom of this page will bring to you, free, the remarkable Phoenix Mutual "Prosperity Plan."

Sending for it is the first step towards real independence—protection for you and your family no matter what happens—an education and every advantage for your children—leisure and comfort for yourself in your later years.

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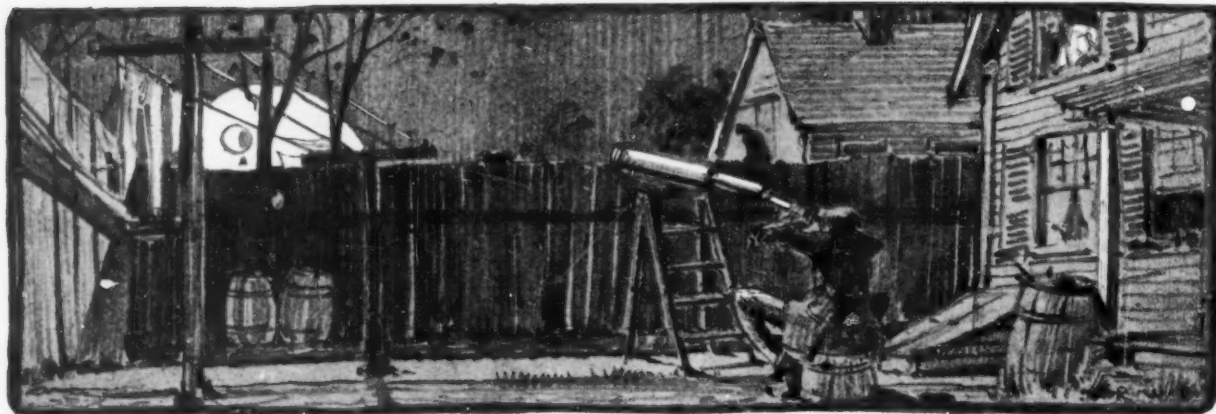
- 1 RETIRE with an income when you are 60 or 65.
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- 5 MAKE sure your income will go on even though you become totally disabled.
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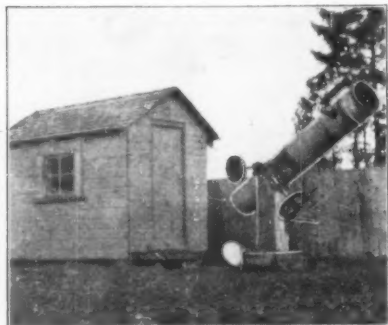




## The Back Yard Astronomer

*A Department Devoted to Interests of the Amateur Telescope Maker*

**A**R. DUNLOP, Box 745, New Westminster, British Columbia, sent in some time ago a photograph of his telescope, which we reproduce. Visible beside the reflector, which has a 12-inch mirror, is



Mr. Dunlop's 12-inch reflector telescope and solar observatory. In the house is a spectroscope

a small building which he has been using to enclose a spectroscope for study of the Sun. Mr. Dunlop writes:

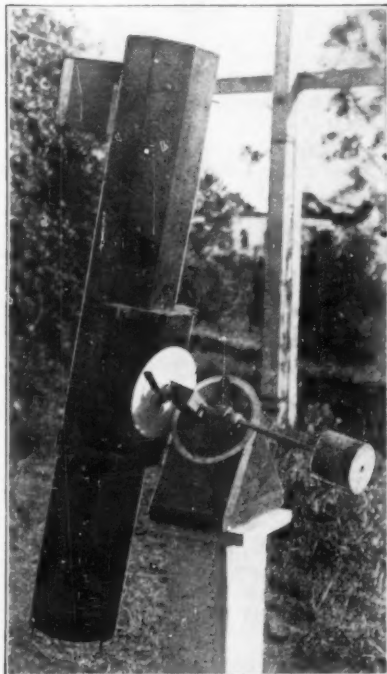
"I feel almost certain that there are dozens of amateurs who could take a lot of pleasure in making a solar spectroscope and watching solar prominences. I do not think there are many amateur astronomers and telescope makers who would not become intensely interested if they saw some of the objects I have seen on the Sun. It is quite common to see great masses of gas shoot up 75,000 or 100,000 miles high, then die away to nothing in a few hours. The forms they take are varied and graceful, in fact no two are ever just alike. Sometimes they are like spikes, again they resemble jets or plumes, or a basket of flowers, and sometimes they look just like ordinary clouds. The latter are termed quiescent prominences, and often look somewhat the same for a long time.

"My experience with small star spectroscopes quite confirms your statement that they are not satisfactory on small telescopes. I do not get very good results even using my 12-inch reflector. I can see only a few lines in bright stars, but even that is of

some interest. I did not know whether the replica grating would work well for solar work or not until I tried it, but I ordered one and have been using it about a year, and it works.

"I am now trying to find out where I can get a larger one and a few more hints on spectroscope construction before I start on a Hale spectrohelioscope."

Since Mr. Dunlop sent us the above letter, Dr. Hale's description of the spectrohelioscope has appeared in the new edition of the SCIENTIFIC AMERICAN book "Amateur Telescope Making," and Mr. Dunlop advises us that he expects to convert his equipment into a spectrohelioscope, using the blueprints mentioned in the book and housing the apparatus in the structure shown in the illustration. All the solar ac-

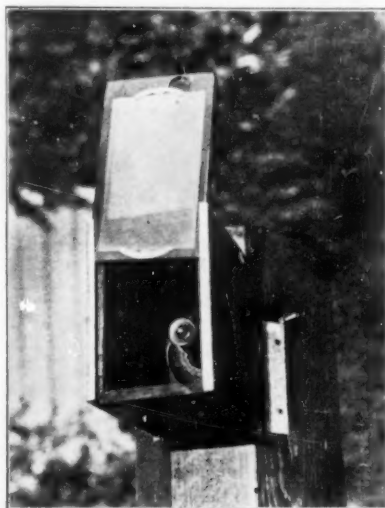


Mr. Lower's telescope with camera attached at the upper end of tube

tivity he describes, and more, can be observed to far better advantage with the new apparatus which can be made at moderate cost.

Harold A. Lower, 1032 Pennsylvania St., San Diego, California, made a telescope which he has used successfully for lunar photography. Mr. Lower writes:

"My telescope was made from the instructions in 'Amateur Telescope Making.' The making of the mirror is so well covered



A close-up of the photographic equipment used on Mr. Lower's telescope shown at the left below

in the book that comment on it is unnecessary. The mount is the German equatorial type and is made from the front hub assembly of an old auto. The only thing needed to adapt it to its new use was to remove the steering spindle bushings and replace them with solid plugs, which were then bored at right angles to the wheel spindle. The wheel spindle forms the polar axis, and as it is mounted on ball bearings it moves very smoothly and easily.

"The telescope tube was made of wood, as in this location the mirror and prism do not fog as quickly in a wooden tube as in

one of metal. There is usually a very heavy dew fall here in San Diego, and the wooden tube enables one to use the telescope when an instrument with a metal tube would be almost useless.

"The setting circles are made from printed paper disks which were purchased for 20 cents each, from a dealer in engineering supplies. They answer the purpose very well.

"The box over the eyepiece is used only for photography, and is easily removed when the telescope is used for visual work.

"I will be glad to get in touch with anyone else who is interested along the same lines that I am."

When the Editor expressed a desire to publish more details about the use of the telescope for lunar photography, Mr. Lower furnished the following statement:

"I have found that it is easy to photograph the Moon with a home-made telescope. A box, open at both ends, is mounted on the telescope over the eyepiece, to hold a plate holder or a ground glass for focusing. An eyepiece of about one-inch focal length is used, partly to magnify the image, and partly because it is more convenient to



From far off Dutch East Indies comes this picture of Mr. de Jager working on his telescope mirror

focus with the eyepiece than to adjust the plate at the focus of the mirror. One should not have the plate more than three or four inches from the eyepiece, as a large image will require too long an exposure.

"I use Eastman cut film, Super Speed, instead of a glass plate, as it is very fast and does not show a halo around a bright object, as do ordinary glass plates. The cut film is placed in a sheet metal adapter and loaded in a plate holder just like a glass plate.

"No shutter is required. A sheet of cardboard is placed over the front of the telescope after the image of the Moon has been focused as sharply as possible on the ground glass. Then a film holder is substituted for the ground glass, the slide is removed, and the exposure made by removing the cardboard from in front of the telescope and replacing it as quickly as possible.

"As Super Speed film is very sensitive, the exposure needed is only about a fifth of a second, which is fast enough to prevent  
(Please turn to page 562)



## The Builder

The power that placed the monster stones of the Pyramids is still open for debate; but who questions that wire rope is the great Builder of today?

Much of the wire rope used in construction is Yellow Strand, that famous brand with *one strand of yellow*. Made in St. Louis and Seattle by a pioneer in the wire rope manufacture, the supreme quality of this king of ropes is recognized throughout the Western Hemisphere and in many countries across the "great waters."

Besides Yellow Strand, this company also makes all standard grades of wire rope for all purposes.

The buyer who writes "Yellow Strand" or "Broderick & Bascom" into his requisitions writes economy into his operations.

### Motorists

You need a Basline Autowline in your car for emergencies. Made of 3/4-inch Yellow Strand wire rope with patented snap hooks for quick attaching. Very strong but small enough to coil flat under a cushion. Ask your accessory dealer.

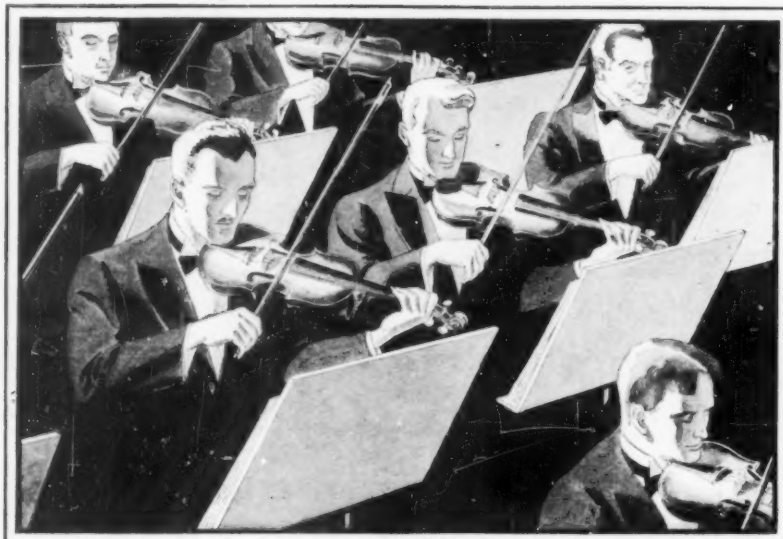
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# Yellow Strand WIRE ROPE



## Where working together is everything

*An Advertisement of the  
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It is the aim of the Bell System that anyone anywhere in the country can pick up a telephone and talk to anyone anywhere else clearly and without delay. That is the meaning of universal service. To provide it, the means of telephoning must be uniformly good. Each of the 24 operating companies of the Bell System has full access to all the improvements and methods that are continually being made.

There are 5000 workers on the staffs of the American Telephone and Telegraph Company and the Bell Laboratories whose sole occupation is to develop constantly improving methods and equipment for the 350,000 employees



of the Bell System to use in serving the public. The results of the efforts are evident, not only in the extension of telephone service across the Atlantic, but in the constantly improving local and long distance service at home.

The very nature of the telephone business necessitates a single interconnected system. The American Telephone and Telegraph Company accepts its responsibility for a nation-wide telephone service as a public trust.

It is fundamental in the policy of the Company that all earnings after regular dividends and a surplus for financial security be used to give more and better service to the public.

## Learning to Use Our Wings

(Continued from page 548)

It is quite possible that airships of this type may have a future as a new kind of air-yachts. The record of the *Puritan* from August 6 of this year to September 15, was a series of flights on 33 days out of 45, covering 5635 miles and carrying 450



The *Pilgrim* taking off from the roof of a department store in Akron, Ohio, where it had previously landed with comparative ease. Other picture on page 548

passengers, which is highly creditable. An objection to airships has been so far in the difficulties of handling. An interesting and new development in this regard is the use of a motor car specially equipped for airship service. A feature of this motorized machine shop is a portable mooring mast to assist in landing.

## Elements of Aviation

COLONEL V. E. CLARK is a rare combination of pilot, airplane designer and aerodynamicist, and his recently published book "Elements of Aviation" (Roland Press, New York City) gives proof of his breadth of view. The author knows aerodynamics, but presents the subject not as an abstract science but as a real introduction to the study of airplane design. The treatment is remarkably clear, and mathematical expressions are reduced to a minimum.

The author modestly disclaims original thought in his treatise, but his methods of presentation are both original and striking. Even an experienced designer will find much to interest him in this elementary book.

Throughout the book we find apt definitions and illustrations. We shall look forward to the companion volume on design which is to follow.

## Aerial Advertising

THE industrial applications of the airplane constantly are being increased. While sky writing has apparently suffered a temporary eclipse, aerial advertising at night is to be undertaken vigorously by Aerial Advertising, Inc., a New York City company.

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A huge biplane, built by the Keystone Aircraft Corporation, with the lower wing of 15 feet greater span than the upper one, so that its total spread is 90 feet, is being equipped with an illuminated sign, 90 feet in length and six feet, six inches in width. Small strips of bass wood, measuring two and a half inches in width are mounted on the underside of the lower wing. The illuminated letters of the advertising sign are secured to these strips.

Six wind-driven electric generators mounted on the wing provide the current for the sign. For extra reliability there are two independent lighting circuits. The tests made on Long Island have shown that these signs can easily be read from an altitude of 3000 feet.

#### Inventions Needed for Safety

WHILE aviation safety is not solely a matter of invention, depending as much on training of personnel, ground organization, et cetera, still many inventions are needed. We can only list a few typical suggestions.

In the structure of the airplane, there is inevitable vibration due to the engine, which cannot be avoided, particularly when only a few cylinders are employed. Perhaps it may be possible to avoid the transmission of vibration from the engine to the rest of the plane, by the employment of rubber as a shock absorber between the engine mount and the rest of the plane.

Radio, lighting, and weather service as aids to navigation, are progressing rapidly. We have still to see a dependable altimeter which will warn the pilot of dangerous proximity to the ground in case of fog. A field localizer which will guide the pilot to the center of a field still remains to be made practical. The danger of collision will increase as the number of planes aloft increases, and some form of collision signal is needed. Television through the fog has been often suggested.

In the aerodynamic design of the plane, as we have often discussed, there is need of devices which will decrease its landing speed without affecting other desirable characteristics.

In the prevention of fire, the production of a light weight engine on the Diesel or semi-Diesel principle, burning heavy, non-inflammable fuel, will be a great boon.

There are many opportunities for engineers and inventors.

#### Popularizing the Science of Flight

THE properties of the wheel, the pulley, the lever are instinctive with us through many generations of use. While the air is all pervading, it is invisible and very much of a mystery. The science of aerodynamics or air flow as applied to the airplane therefore needs popularization, and a number of authors have undertaken to write simple accounts of the theory and construction of the airplane. Such works will do a great deal of good to the cause of aviation.

They are very much harder to write than technical treatises in which mathematical language can be freely used. We have recently received an excellent book of this type, "The ABC of Flight" by W. Laurence Le Page, published by John Wiley and Sons. In simple language with clear diagrams Mr. Le Page explains the fundamental principles of flight, how stability and control are achieved, how an airplane is built, and the elements of flying instruction.

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### Industries From Atoms

(Continued from page 545)

Atchison, Topeka, and Santa Fe Railway during the last 15 years is of convincing interest.

In October, 1913, a number of southern pine fence posts were placed along the right of way at Cleveland, Texas, to obtain information on the relative life of untreated posts, posts treated with the standard preservatives—zinc chloride and coal-tar creosote—and those treated by various other methods and with materials claimed to possess preservative properties. These posts were inspected three, six, seven, eight, 11 and 14 years after being placed in service.

A summary of these records indicates the comparative value of thorough treatment and brush treatment and of standard preservatives and non-standard materials. The untreated posts were decayed three years later. Brush treated posts and those treated with various non-standard materials were decayed in three years and removed at various periods after seven years, the few standing at the end of 13 years being held up only by some heartwood still remaining. Posts, pressure-treated with coal-tar creosote and with 1.28 pounds of zinc chloride per cubic foot, were in excellent condition without signs of decay, after 14 years of service. Only one of the posts treated with the light absorption of 0.417 pounds of zinc chloride per cubic foot showed decay after 11 years' service.

### Faith in Research Leads Firm on Unique Path to Profits

FROM the manufacture of baking powder to the production of sheet metal seems like a long step for a manufacturer to take but such was the perfectly logical step taken by the R. Hardesty Manufacturing Company of Denver, Colorado, as a result of their confidence in the economic value of chemical research.

The Hardesty Company made baking powder and flavoring extracts in Denver. Their baking powder cans were shipped to them from eastern manufacturers. Their research men pointed out that it would be quite feasible for the company to make its own cans and accordingly a plant was started. Eventually the demand for cans in the western district became so large that the company found it advisable to drop its original line entirely and devote itself exclusively to the production of containers.

The research men were still on the job and advised the extension of the company's line to include sheet iron irrigation flumes to replace the wooden flumes long used by the Colorado farmers. Then came the sheet metal road culvert at first called impractical. The research men made it practical. Tanks, valves, metal drums, street signs, measuring weirs, and many other products have been added, each after an investigation of the technical possibility as well as of the market situation. Thus for nearly 40 years an industrial concern, far from the manufacturing centers, has kept busy and growing and today is still searching for new things to make to keep its facilities busy.

### Science Seek: Safer Safes

SAFER safes is the goal of a regular program of scientific study at the United States Bureau of Standards. Additions to the safe-testing equipment of the

COMMANDER RICHARD E. BYRD says:

"Without these men the polar regions would never have heard an aeroplane engine."

## INDUSTRIAL EXPLORERS

By MAURICE HOLLAND

"AS dramatic and interesting as the stories of those who spend their lives in the unknown parts of the world," says Commander Byrd.

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**MILLER:** The enthusiastic boy who tumbled off a cliff in Oklahoma in his first attempt to fly, now makes Curtis planes—each one faster than the last.

**SPERRY:** Known widely for his gyro-compass "Metal Mike," he has now lighted the way of aviators and ships with his powerful searchlight brighter than the sun.

**REESE:** He turned millions of pounds of wartime TNT into a safe explosive for farmers.

**McMILLAN:** Trains thunder across gigantic viaducts in safety because this man's insatiable curiosity led him to explore the atoms in concrete.

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"HOLLAND has done in this book for science in industry what Paul de Kruif did in his *Microbe Hunters* for science in medicine. It is composed of character sketches of the real leaders of American progress."—Edwin E. Slosson.

"Holland's book will present these heroes to the American public which owes them a great indebtedness for many blessings which their laboratories have conferred upon our present American civilization."—Michael I. Pupin.

bureau have been recently completed. With them, loads can be applied to the safes before, during or after the fire test. Such load application will be made to determine the degree of strength and rigidity of safe structure required to preserve the proper alignment of door and jambs under ordinary conditions of use. Loads can also be applied to safes by methods that will give information on resistance to such impacts as safes receive from failure to building walls and floors in fires.

The equipment has been further supplemented with a conditioning chamber that can be equipped for conditioning safes under given temperature and humidity conditions. The amount of water, free and



Although experiments in chemical laboratories subject concrete to all sorts of tests, it remained for a fire in Fall River, Massachusetts to produce this eloquent testimony of the fire-proof qualities of a concrete vault. This safe in the Troy Co-operative Bank preserved all its contents, while steel filing cabinets were ruined

combined, that the insulation of a safe will permanently retain determines to a considerable extent the effectiveness of the safe in preserving its contents from fire after a long period of use. Some manufacturers subject the safes after filling, or the filling itself, to a drying process to drive off excess moisture. In fire-endurance tests of safes conducted soon after they have been filled, the weight losses from water evaporation generally range from 15 to 30 percent of the weight of the insulation, or a water loss for the larger safes of from 300 to 600 pounds, equivalent approximately to 35 to 70 gallons.

#### New Tricks With the Carbonyl Radicle

THE chemist can never guess into what fields his researches will lead him. A. Mittasch, one of the distinguished experts of the German dye trust, has discovered a new anti-knock compound, a photographic chemical, and a remarkable new kind of iron, all as a result of his study of the



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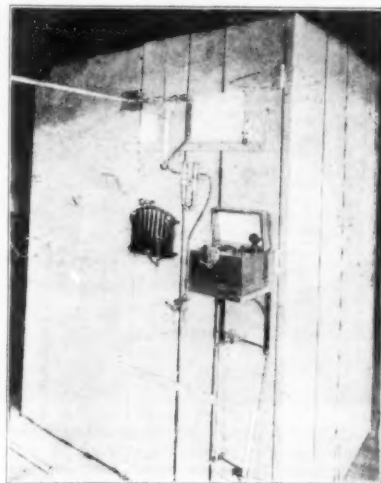
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characteristic properties of ferric carbonyl,  $\text{Fe}(\text{CO})$ , a procedure adaptable as a new method for making photographic copies. A remarkable substance called "Carbonyl iron" is formed when ferric carbonyl is heated under special conditions. It is a very pure iron powder characterized by high permeability, low hysteresis, and low eddy-current losses, making advantageous its use in magnetic cores and Pupin coils. Its high purity and extreme degree of subdivision, however, make it especially adapted for catalytic uses: thus, when touched by a glowing match, it burns with an intense flame.

### Those Versatile X-rays

There was an old maid from Duluth,  
Who, when she had left but one tooth,  
Made her living with ease  
Biting holes in Swiss cheese.  
Now wasn't she cunning, forsooth?

Stop me if you've heard that one, but it just would perpetrate itself as a preface to



At the University of Illinois, apparatus for research in the behavior of gases at high pressures has been developed in order to study the new methods of producing methanol (wood alcohol) from water gas. This photograph shows the catalyst chamber where methanol is produced by means of a mixture of carbon monoxide with hydrogen gases

this latest application of the X ray to the examination of the size and location of desired holes in that excellent comestible. In addition to that, Dr. George L. Clark in a recent issue of the *Catalyst* reminds us of other new marvels of the X ray as follows:

"The physicists have used them to explore the inner structure of atoms and the chemists have discovered new elements with the aid of X-ray spectrographs.

"There are three general types of X-ray examination; one deals with the gross structure of objects as shown by radiographs; second, the fine structure of matter as deduced from the characteristic X ray diffraction patterns produced by the substance under examination; and third, the spectrographic study of materials used as targets in X-ray tubes. A few typical illustrations of the numerous practical

## MODEL AIRPLANES

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uses of X rays in determining gross structure include the determination of the symmetry of golf-ball centers, the adhesion of rubber to cords in tires, inspection of reclaimed rubber for nails and foreign matter, examination of insulated wire, the inspection for worm holes, knots and cracks, of wood used in airplanes, inspection of walls for hidden wires and pipes, examination of old paintings for retouching and for superposed pictures."

The examination of the fine structure of materials has been most fruitful in producing invaluable fundamental information. In 1912, Lane made the brilliant discovery that an ordinary crystal will diffract X-rays in a manner similar to that in which a diffraction grating diffracts the visible light rays. So remarkable has been the development of this discovery that today we know more about the solid state of matter than either the liquid or gaseous states. These studies have divulged the arrangement and number of atoms in the ultimate crystal of many metals, alloys, and inorganic and organic compounds.

Improved equipment has made it possible to examine crystalline organic compounds as well as metals and heavy elements. Hence today X rays are being utilized in efforts to interpret stereoisomerism, optical activity, and other properties of organic substances. Mixed crystals as found in paraffin waxes have been examined and the diffraction pattern obtained was apparently that of one hydrocarbon.

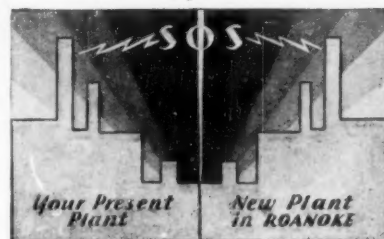
Colloidal and amorphous substances have been investigated more recently. Rubber, when stretched, has shown a crystalline fiber diffraction pattern. Cellulose has proven to be crystalline (rhombic) and to have the composition  $(C_6H_{10}O_5)_n$ . Amorphous substances may exhibit patterns made up of 2 or 3 diffuse diffraction rings which appear to indicate the distance of nearest approach of the molecules in the materials. The industrial applications of X rays are almost countless.

### Measuring the Temperature of Flames

FLAMES produced by the combustion of gases and vapors are used in many industrial operations; they cook our food, heat our houses, and even furnish motive power for our automobiles. The efficiency of flames in doing their work is often related closely to their temperature, but up to the present time there have been few actual measurements of the temperature of such flames.

The flame laboratory of the Pittsburgh Experiment Station of the United States Bureau of Mines is making direct measurements of the temperature of flames in connection with a study of the physics and chemistry of combustion and explosion. It has been found that the brightness of a flame colored yellow with sodium chloride vapor is directly proportional to the flame temperature, and in the method employed at the Bureau of Mines laboratory the intensity of this light is compared in a spectroscope with light from a tungsten band heated to a known temperature. Measurements have been made on flames of natural gas, methane, propane, and carbon monoxide and the work is being extended to include all the commonly used gases and vapors, mixed both with air and with oxygen, and in different types of burners.

## A Plant in This Fast Growing City



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ALREADY the strategic advantages of Roanoke have resulted in the location here of 113 different industries. Among them are the largest artificial silk (rayon) mill in the world and other industrial plants the largest of their kind in the South. Roanoke is also a distributing center for some of the nation's leading manufacturers.

What is it about Roanoke that attracts industries and enables them to prosper here? Why has Roanoke doubled its population during the past seventeen years? What caused it to grow from a mere 669 inhabitants in 1880 to a community population of 80,000 today?

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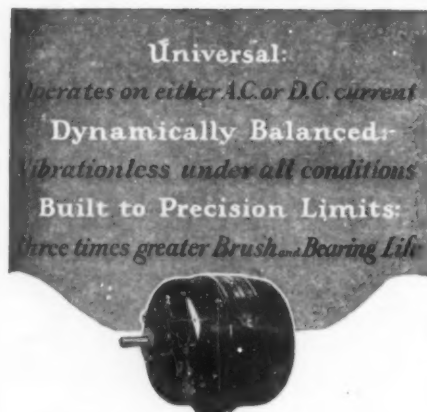
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### The Back Yard Astronomer

(Continued from page 555)

blurring of the image due to the motion of the Moon when the telescope is not equipped with clock drive.

"The enclosed pictures of the Moon were made with a six inch mirror and an eyepiece of about  $\frac{3}{4}$  inch focal length. I believe I can make better ones, but these will give a fair idea of what one can do with a six-inch mirror." (One of these is reproduced in "Amateur Telescope Making."—Ed.)

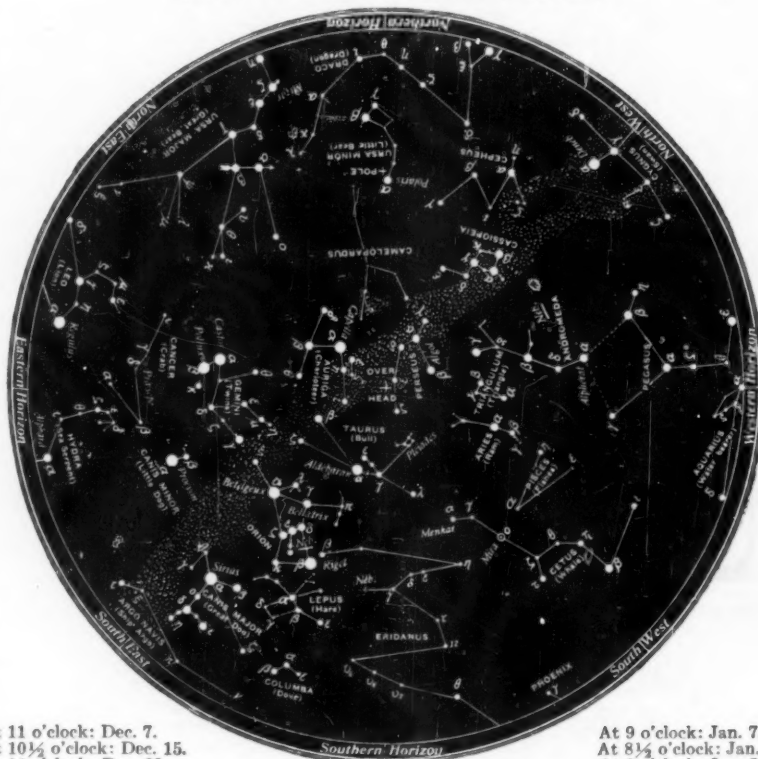
"An ordinary negative eyepiece works all right, but an achromatic eyepiece would probably be better with high magnification."

J. M. de Jager, Embong Kenongo 33, Soerabaja, Java, Dutch East Indies, sent us rather long ago a photograph showing progress on a six-inch mirror. It is a long way from America to Java but we have records of amateurs making telescopes in many other distant lands and we here urge them to send us photographs and descriptions of their telescopes. Says Mr. de Jager:

"In my last letter to you I promised to write to you about my progress while making the mirror of my future telescope. As I have only a little spare time, I progress very slowly. I send you the photograph. You can see that I am working temporarily in the open air."—A. G. I., Tel. Ed.

## The Heavens in December

By PROF. HENRY NORRIS RUSSELL, Ph.D.



At 11 o'clock: Dec. 7.  
At 10 $\frac{1}{2}$  o'clock: Dec. 15.  
At 10 o'clock: Dec. 23.

At 9 $\frac{1}{2}$  o'clock: December 30.

At 9 o'clock: Jan. 7.  
At 8 $\frac{1}{2}$  o'clock: Jan. 14.  
At 8 o'clock: Jan. 22.

### NIGHT SKY: DECEMBER AND JANUARY

**M**ERCURY is in conjunction with the Sun on the 18th, and is practically invisible this month. Venus is an evening star and is growing more conspicuous as she comes north. At the end of the year she remains above the horizon until after 8 P. M. and is very prominent.

Mars is in opposition to the Sun on the 21st; he is in the western part of Gemini and about as far north of the celestial equator as he ever can get, reaching the high declination of  $26^{\circ} 47'$  at the end of the month. This adds to his prominence but he is in the part of his orbit which lies farthest from the Sun and is therefore not as near the Earth as he was in 1924 or 1926. His nearest approach, which comes on December 16, leaves him at a distance of 55,000,000 miles. He therefore appears smaller in the telescope and fainter to the eye than in recent years; even so, he is a fine object—almost as bright as Sirius.

Jupiter is in Aries and may be seen in the south about 8 P. M. Saturn is in conjunction with the Sun on the 13th and cannot be observed. Uranus is in eastern quadrature on the 25th, and is on the meridian at 6 P. M. Neptune is observable telescopically in the early morning.

The Moon is in her last quarter at 9 P. M. on the 3rd; new just after midnight on the 12th; in her first quarter at 10 P. M. on the 19th, and full at 3 P. M. on the 26th. She is nearest the Earth on the 26th and farthest away on the 11th. As she makes her circuit of the heavens she passes Neptune on the 2nd, Mercury on the 11th, Saturn on the 12th, Venus on the 15th, Uranus on the 20th, Jupiter on the 22nd, Mars on the 26th, and Neptune for the second time on the 30th.

At 10:04 P. M. on December 21, the Sun reaches the southernmost point of his track and "winter begins."



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## The Scientific American Digest

(Continued from page 543)

being placed directly under the hopper of the car. As the material falls down on the device a wide rubber-covered belt carries it away to a point for unloading into trucks or upon a pile from which another conveyor may take it for storage or delivery. The belt of the unloader is operated by means of an electric motor or a gasoline engine, and as this means of power is detachable, the device may be easily handled by one or two men. Depending upon the nature of the material unloaded, the machine can easily handle from one to three tons per minute.

## Skyscraper Endurance

IN a recent issue of SCIENTIFIC AMERICAN, there appeared an editorial entitled "Will Skyscrapers Endure?" This editorial was based upon an alleged interview with Sir Edwin Lutyens the eminent British Architect, who is said to have commented on the condition of the steel work in the recently demolished old Madison Square Garden. He is said to have criticized steel construction.

The American Institute of Steel Construction, Inc., calls our attention to the fact that when the account of this alleged interview first appeared in America, they telegraphed Sir Edwin asking the basis of his reported statement. He cabled in return that the statement was not authorized by him.

The Institute in commenting further, stated: "SCIENTIFIC AMERICAN has plenty of authority for the position it has taken in the editorial insofar as the engineering problems are concerned, and you are fully justified in defending the American skyscraper and the building practices followed in the United States."

We regret that we have given further circulation to this report which turns out to be baseless.

## Man Became Erect-Postured From Pulling at Branches

MAN owes his present proudly erect position to a long line of tree-dwelling ancestors. Brachiation—which means pulling one's self about among the branches—is the only way in which the spinal column could have gained an upright position, declared Dr. William K. Gregory of the American Museum of Natural History, speaking in Philadelphia recently before the meeting of the American Philosophical Society. A series of the upper arm bones of primitive mammals, lemurs, monkeys, and apes, shows increasing resemblance to the corresponding bone in the human arm, he stated, and there are many further details of structure, especially in the hand and foot of man, that indicate a former tree-dwelling mode of life.—Science Service.

## Food for the Fish

DO bugs, millers, moths, flies, beetles, and all the other insects have any preference as to the color of the light around which they like to swarm and swirl on warm summer evenings? No, says the Izaak Walton League of Fort Wayne, Indiana, which has combined business with pleasure in the installation of floodlights of various hues around the lagoons in Lakeside Park there.

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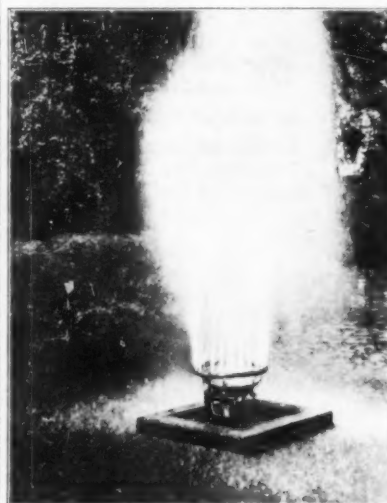
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Visitors to the park might, with reason, be led to believe that the colored floodlights had been installed to add to the natural beauty of the park, but there is more to the story. The underlying motive for the lights is that in the five lagoons of the lake are fish of many kinds and sizes, for the lake is used as a hatchery by the disciples of Izaak. Fish must be fed, and they prefer insects. But a hatchery, with its concentrated population, needs an extra abundance of insects above



The waterproof light under this fountain attracts insects at night and the spray throws them into the water as food for the fishes

and in the water if all the finny denizens are to have their appetites appeased. And hence the lights to lure the insects to their destruction.

Some might think that enough had been done for the fish by the installation of the lights. Plenty of the flyers would circle the lights until tired, and then drop into the lake or even directly into the gaping jaws of the waiting fish—and enough of them would also fly low enough so that the more lively fish could obtain their food by quick jumps into the air.

But no unnecessary or undesired exertion for Fort Wayne fish, says the league. If the fish would rather wait and have their dinners served, it can be arranged. Hence the installation of sprays, not to wash off the bugs, but to wash them into the lake. And the sprays serve still another purpose, for they aerate the water—to say nothing of the fact that the beauty of the lake is further enhanced by them.

Operation of the fish hatchery is conducted jointly by the city park board and the local chapter of the Izaak Walton League. The bug-catcher installation includes five General Electric submarine-type floodlights, equipped with different colored glass fronts, installed within ring sprays.

### Pineapple Water Tank

**R**EARING its 30-ton bulk 195 feet into the air, a giant water tank stands atop the new 500,000 dollar office and warehouse building of the Hawaiian Pineapple Company at Iwilei, Hawaii. It has been shaped and painted to represent a ripe pineapple, even to the green steel "leaves" of the crown. It will serve as a

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water tank to provide fire protection not only for the company's plant but for that of the American Can Company which is nearby, and as a beacon to aid ships entering Honolulu Harbor. It will have a water capacity of 100,000 gallons.

The completed "pine" is lighted all night by flood lights. Lights come from three sources, with two searchlights at each point. Each light has a capacity of 1000 watts, although at present only



The water tank on a building of the Hawaiian Pineapple Company. It serves as fire-protection and as a beacon for harbor navigators

750 watts are installed in each. The supporting tower is painted so that, when the tank is lighted, only the tank will be visible, the effect being that of a giant pineapple suspended in the sky.

## New Camera Films Give Correct Color Values

AMATEUR photographers with roll film cameras can now take pictures of colored objects in which light red objects appear light, while a dark blue photograph dark. A large film manufacturing concern in London, England, is now producing "panchromatic" roll films. These do not take pictures in natural colors, but they do reproduce color values correctly. With ordinary films, red photographs black or very dark, while blues appear very light.

Panchromatic plates have been on the market for some years, while similar film has been made for use in movie cameras. However, it has never been obtainable before for roll film cameras, which are most commonly used. The film is not very much more expensive than the ordinary kind. As the films are sensitive to red light, they cannot be developed with the ordinary red dark-room lamp. The film manufacturers, however, will develop them.

—Science Service.

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# Commercial Property News

## *A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights*

### The Flying Paster

INTO one end of a mammoth printing press a roll of plain paper is being fed. Out from the other end drops, faster than you can count, copy after copy of a 64-page newspaper, completely printed and folded. The roll of paper is about exhausted. Paste is placed on the outside of the loose end, the press is slowed down a bit, a motor-rotated reel brings up a new roll in contact with the old, and the press speeds up again. The old expired roll is removed from the reel and a full roll put in place.

This joining of the old and new rolls is a practice termed "a flying paster," and permits a continuous feeding of paper to the press without stopping the press to change from one roll to another. In newspaper printing, where every saving of a moment's time is of the greatest importance, its achievement is of great value. How valuable it may be to the holder of the patent is evidenced by the fact that in five years he made installations in large newspaper offices for an aggregate price of 1,300,000 dollars.

The inventor, Irving Stone, applied for his patent in 1900, but it was not issued until 1915. Before that time he had assigned his rights to one Kohler. Only in 1919 did it begin to be adopted widely and rapidly. In that year the Cline Manu-

findings are illuminating on the question of prior public use.

The Cline and Westinghouse companies contended that the patent was invalid on the ground that the device was used more than two years before the date the patent was applied for. They showed that Stone, who was mechanical superintendent for the Chicago News, had installed there a multi-reel feeding device for two new presses. Soon thereafter, it was shown, the pressmen became so expert that they could cut out the expiring roll and paste the severed web to the new roll, thus continuing the operation of the press by very materially slowing it down, but not stopping it. This was in a sense a flying paster, manually made. The testimony of witnesses as to their recollection of the exact method of operation in 1897 was more or less contradictory.

"It is quite elementary," says Judge Alschuler, "that to strike down a patent upon the ground that the patented article was in public use more than two years before the application was filed, this fact must be established by evidence so clear as to satisfy beyond reasonable doubt; and the evidence must so satisfy not alone as to the time, but also that the use was of the very thing which was patented."

That the inventor and the assignee appreciated the value of their patent is

file wrapper, which shows a pendency of 14½ years, without as much as an interference proceeding to consume the time. Applicant made 12 amendments, in each instance delaying within a week of a full year following the next proceeding action of the Patent Office. But this being within the law as it then was, the validity of the patent is not thereby affected."

### Stopping Leaks in Radiators

HOW many a "tin can tourist," finding a leak in the radiator of his car, has gone into a drug store, bought some flaxseed, dumped it into the water in the radiator and then forgotten about it? Or maybe he used rice flour, oatmeal, sugar, flake asbestos, or graphite. They also would stop such a leak just as well.

Louis J. Stern, of Boston, however, saw possibilities in such a method of stopping a radiator leak. On October 15th, 1918, he obtained a patent on a method of stopping leaks in metal vessels which "involves the employment of a leak stopping ingredient which with water is adapted to form a colloidal solution." In his patent Stern stated that the essential constituent of the composition is a substance commercially known as cube gambier, which is an extract from certain trees or shrubs and contains catechin and tannin, although some other bark extracts may be employed.

It was no great time before the leak stopping compound was on the market in half-pint cans at six dollars each. The inventor's assignee, E. R. Tolfree, was making it in his plant known as X Laboratories, and selling it at that price. And S. G. Wetzler, of the Blue Seal Chemical Company, began to make it too. The usefulness of the solution is evidenced by the large public buying at the high price. It was used on most of the long distance airplane flights beginning with the NC-4 transatlantic flight in 1919, and including the McMillan Arctic expedition of 1925.

Tolfree sued Wetzler for infringement. He lost in the Federal District Court in New Jersey, but took the case up to the Circuit Court of Appeals. There the lower court was reversed, the patent was declared valid and Wetzler was ordered to make a complete accounting. Judge Buffington said:

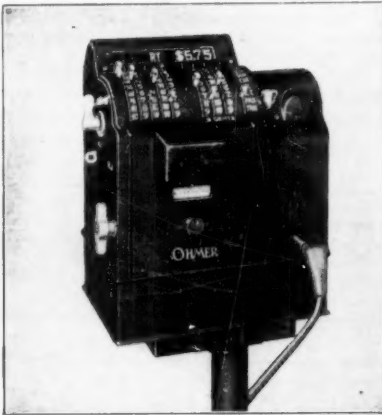
"The results in metal leak stopping by this fluid solution present a case of an unusual kind and we are satisfied the contribution of this patentee to the art was one so effective, unlooked for and simple as to brand it unusual in character.

"Moreover, the disclosure was original and novel. Gambier had been used for years in the tanning art and in other ways; its qualities were known. But no one before Stern conceived the idea of using gambier in suspension in water where the solution would remain fluid until a leak occurred.

"The use of gambier for such purposes, its continuing in suspension in water, its



The fact that "knocking down" by conductors on street cars and buses in the United States amounts to 40,000,000 dollars a year, has provided John F. Ohmer with an opportunity for invention. His device not only records the fare, but prints a ticket stating the points between which the passenger is traveling. It may eliminate the selling of tickets in stations



facturing Company, in conjunction with the Westinghouse Company, installed press-feeding machinery embodying the Stone invention in the plant of the Chicago Tribune, undertaking to protect the Tribune against all claims for infringement. Kohler sued the Cline and Westinghouse companies and at last obtained a decree from the Federal District Court for the Northern District of Illinois, holding the patent valid and infringed. The case was appealed and now Judge Alschuler has written the opinion for the Circuit Court of Appeals. His

evidenced by the long time they kept it pending, for the purpose, apparently, of putting off the date of expiration as late as possible. It is a costly process and sometimes a dangerous one, but it is wholly within the law. On this point Judge Alschuler says:

"The defense of invalidity urged in the District Court, based on delay in prosecution of the application for the patent, is not seriously urged here. That the prosecution was most extraordinarily procrastinated is manifest from inspection of the

faculty of not clogging the channel, its solidifying when escaping through the leak, all matters elemental in this method and use of colloidal state, made a combination so unusual, unexpected, novel and useful as to place it in the zone of invention."

Judge Davis was not impressed by such reasoning. In a dissenting opinion he said:

"The evidence, as a whole, amounts to this: Gambier used as a composition by an old method, well known in the prior art, to stop leaks in metal vessels, such as automobile radiators, is 'superior' to other compositions used in the same way. Such use of gambier in my opinion does not constitute a valid method patent. I think the decree of the District Court should be affirmed, and so I am constrained to dissent from the majority opinion of the court."

### Mortgages and Admiralty Liens

WHEN is a boat not a boat?

About the answer to that question recently revolved a 300,000 dollar mortgage foreclosure suit. The Federal District Court for Southern Florida answered one way, and the Circuit Court of Appeals for the Fifth Circuit in exactly the opposite way. Here are the facts.

The Shoreland Company, a Florida Corporation, owned a tract of land on Biscayne Bay and was engaged in filling it by pumping sand and other material from the bottom of the bay. For this work it acquired the steam suction dredges *Lawrence* and *Massachusetts*. In October, 1926, Robert McArdle filed libels against both dredges, claiming maritime liens for supplies, equipment, labor, and money advanced. A number of other parties filed similar liens. The J. C. Penney Corporation held a mortgage for 300,000 dollars covering both dredges. In October, 1927, a decree was entered allowing the claims as maritime liens and allowing also the claim of the J. C. Penney Corporation under its mortgage, subordinating it to the maritime liens. The dredges were sold and the money deposited in court. The maritime claims absorbed the entire proceeds. The holder of the mortgage apparently was out of luck; it took an appeal.

The whole case hinged on whether the dredge boats were boats, and, therefore, subject to admiralty law. If so, the claims of the maritime supply men should be satisfied first; if not, the mortgagee was entitled to its share. Judge Foster, writing the opinion of the Circuit Court of Appeals, straightened it out as follows:

"There is no doubt that a dredge boat engaged in navigation, or in doing work for the purpose of improving a channel, or that will be an aid to navigation, in certain circumstances, is subject to admiralty jurisdiction, but a distinction is made where a vessel or other floating structure is not so engaged. It is essential that in order to maintain an admiralty lien on a vessel for supplies or advances, that she be at the time engaged in a maritime venture. It is clear that such is not the case here.

"Of course, the dredging deepened the water where the material was removed but that was merely incidental to the work being done. The dredges were not engaged in either commerce or navigation. The purpose of employing them was to make improvements on land, not for the purpose of aiding maritime commerce, but to fill up the land, in order to bring it to the required grade, for the purpose of sale. The prin-

ciple underlying maritime liens is that the supplies furnished are intended to benefit the ship and not the owner. No maritime liens were created on the dredges for any of the supplies, or advances shown to have been made."

### Chile's New Regulations

THE Chilean government recently has promulgated a new regulation settling some questions which have caused considerable controversy in trademark registration. Among the changes is a new interpretation of the right to register.

Heretofore anyone could register a trademark, provided it had not previously been registered and it did not fall within certain specific exceptions. Ownership of the mark was conceded automatically to the registrant.

Under the new interpretation, the Trademark Office will undertake an investigation to ascertain whether the person applying is the manufacturer or the dealer in the article, or is the owner of the establishment which the mark signifies, or whether the mark has not been registered or in use within the country for a period of at least one year. Publication will be made of applications at least 30 days prior to acceptance of registration, and owners of marks may contest the application, provided they can prove prior ownership and use within the country for at least a year.

If the trademark has been in use for more than a year by two or more persons, the registrant must permit the others to continue using that mark. Certain defi-

nitions also are given as to what constitutes graphic or phonetic similarity which would prevent registration.

### Our Changing Trademark Law

TIME was when the rules governing ownership of trademarks were simple ones. A man could not extend his mark beyond the class of goods he sold. Another might use the same trademark for dissimilar articles and the first user would not be heard to protest. What harm would it do a piano manufacturer, the courts reasoned, to have a hosiery mill use the same trademark? One could never by any stretch of the imagination divert sales from the other.

That there is a change in the attitude of courts, however, is indicated by the successful effort made by the Yale and Towne Manufacturing Company to prevent the Yale Electric Corporation from registering the notation "Yale" for flashlights and batteries. Yale and Towne make locks.

"It has of recent years been recognized," declare Judges Learned Hand, Swan and A. N. Hand in the Circuit Court of Appeals for the Second Circuit, "that a merchant may have a sufficient economic interest in the use of his mark outside the field of his own exploitation to justify interposition by a court. His mark is his authentic seal; by it he vouches for the goods which bear it; it carries his name for good or ill. If another uses it, he borrows the owner's reputation, whose quality no longer lies within his own control. This is an injury

## Patents Recently Issued

### Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

#### Pertaining to Apparel

CORSET—A one-piece knit seamless and shaped combination corset and brassiere, which will act as a reducer, and has an upper curved portion at the front. Patent 1683510. O. C. Wiese, c/o Leon Rubenstein, Security Mills, Inc., Newton, Mass.

#### Pertaining to Aeronautics

AIRCRAFT—Having means whereby the ends of the planes or wings may be projected during the take-off, or during landing, and can be drawn inwardly at the will of the operator during flight. Patent 1685014. A. A. Anderson, 80 W. 40th St., New York, N. Y.

#### Chemical Processes

CENTRIFUGAL LIQUID CRUCIBLE—Comprising a vessel provided with a refractory lining and adapted to contain molten metal to form a crucible, an electrical conductor embedded in the lining, and means for rotating the vessel. Patent 1684890. J. Maximoff and M. S. deCosta, c/o C. Chassevent, 11 Boulevard de Magenta, Paris, France.

#### Designs

DESIGN FOR A PINCUSHION—Patent 76237. Ellen L. Harrison, 847 Lexington Ave., New York, N. Y.

DESIGN FOR A WEATHER VANE—Patent 76316. E. W. Lawson, 509 "O" St., West Palm Beach, Fla.

#### Electrical Devices

RADIANT-HEATER ATTACHMENT—By which the heat generated is circulated by thermal action through the interior and against the exterior of the attachment thus increasing the heating efficiency. Patent 1682038. G. L. Davenport, Jr., 1430 W. 52nd St., Los Angeles, Calif.

RADIO RECEIVING CIRCUIT—The object of which is to overcome objectionable radio frequency oscillations originated either in the receiver itself, or imposed upon the receiver by external impulses. Patent 1685043. J. M. Cartwright, Helena, Ark.

RHEOSTAT—Of the grid type having a supplementary or auxiliary grid by the particular use of which alternating current may be adapted to welding purposes. Patent 1685714. T. B. Moorer, Summerville, S. C.

ATTACHABLE SHOWER—Which may be readily secured to a bath tub without the assistance of a plumber, will guide the water into the tub, and prevent splashing the floor. Patent 1685180. J. C. Sheller, 410 St. Charles Rd., Maywood, Ill.

SCARIFIER TOOTH—So constructed as to permit of reversal in its shank, thereby presenting a fresh point for engaging the road or other surface to be worked. Patent 1685196. C. E. Gilbert, c/o Gilbert Mfg. Co., Stillwater, Min.

even though the borrower does not tarnish it, or divert any sales by its use, for a reputation, like a face, is the symbol of its possessor and creator, and another can use it only as a mask. And so it has come to be recognized that unless the borrower's use is so foreign to the owner's as to insure against any identification of the two, it is unlawful."

### Patents for Color Sequences

**A**n interesting example of the distinction between what is patentable and what is not, is provided by a recent decision of the Board of Appeals of the Patent Office allowing some of the claims in a patent application by Charles Stolp, Jr., and rejecting others. Some of Stolp's claims were for a roof of such a color arrangement that a distinctive pattern was avoided. These were held to be unpatentable, since they were for the production of an ornamental effect and did not come within any of the statutory clauses of invention.

On the other hand, claims were allowed which were directed to a package of colored shingles so arranged, that the builder can take them in the order in which they are packed and produce the color effect desired on the roof.

The Board says:

"In our opinion, anyone should be free to use his own judgment as to the obtaining of a proper effect, and we do not see that the use of a larger number of shingles of the predominant color, a smaller number of a harmonious shade and a still smaller number of contrasting color of itself would produce the result which in the end must come from the judicious distribution of these shingles on the roof.

"Claims 5 to 11 inclusive, cover a package of shingles of different color which are so arranged in the package, that when laid in regular order on the roof, the desired effect will be produced without requiring any special care on the part of the workmen.

"We do not think that the package of playing cards cited by the Examiner, would suggest this invention, and we believe there is sufficient merit in these claims to justify their allowance."

### Steel Wool to Catch Soot

**T**HERE are two ways in which an inventor might start to work. He might take an article and seek out a way to use it, or he might see a need for some article to perform a certain function and then seek for such an article. In either case, the inventor is beginning with a solid foundation; his measure of success depends upon how practical he is.

Using one of these situations as a basis, Maxemilean Koehler made an invention. He recognized that greasy soot arises from a kitchen range oven and fouls the kitchen walls and hangings. Others, attempting to remove the soot and grease from heated gases have tried asbestos fiber and other filters, but they have been unsuccessful because the filtering material quickly became foul. Koehler conceived the idea of using "mineral wool, asbestos, hair, or the like" as a filtering medium. He obtained a patent. This was not entirely satisfactory, however, and he kept working away at the problem until he hit upon steel wool. By passing the fumes from the oven through a flue having a filter mat of steel wool, he found that the soot and grease

### Of Interest to Farmers

**CULTIVATOR**—Of the sulky type, especially adapted for cultivating corn, will efficiently destroy weeds, and will not become clogged when the soil is wet. Patent 1683008. R. Aarvig, c/o John H. Bruninga, 1706 Railway Exchange Bldg., St. Louis, Mo.

**AUTOMATIC POULTRY FEEDER**—In which a supply of feed is released and distributed at any predetermined hour, the release being accompanied by an alarm to arouse the poultry, and illuminating means. Patent 1684334. R. F. Toope, Box 959, New Haven, Conn.

**HONEY RICK**—For use in bee-hive supers, in which honey deposited by the bees automatically drains into a container, which may be readily drained and replaced in the super. Patent 1685021. S. G. Broyles, Battle Mountain, Nevada.

### Of General Interest

**COMPACT-PLATE-FOLDING RING**—For holding a compact and its supporting plate in a vanity case, the ring holder interlocking with the case, yet permitting easy removal. Patent 1683552. W. G. Kendall, 118 Market St., Newark, N. J.

**SCRUBBING MOP**—Which may be subjected to heavy wear, the yarn of which will automatically spread and rapidly dry, when the mop is inverted after use. Patent 1683549. E. P. Jones, 228 E. Washington St., Pulaski, Tenn.

**RECLINING COUCH**—In which the head section may be manually moved to the desired angle and securely held in adjustment, the device is also applicable to a chair back. Patent 1683513. T. Wolf, 251 Central Ave., Union City, N. J.

**WEATHER STRIP**—Including a base and a flexible element adapted to be applied to a door jamb or sill, to engage the side edge, or bottom surface of the door. Patent 1683564. A. Miller, 70 Greenwood Ave., East Orange, N. J.

**ROPE CLIP**—Including U-bolt clamps for bending or cramping rope, for rope end loops and splices, the U-bolt clamps having upstanding centrally there between a spreading stud. Patent 1683512. H. Wisbauer, c/o Penn Alto Hotel, Altoona, Penn.

**HAIR WAVING OUTFIT**—A structure capable of winding the hair from a point close to the scalp, after the moistening pad and heating element have been placed in position. Patent 1683531. G. Decker, c/o The Realistic Permanent Waving Mfg. Co., Cleveland, Ohio.

**CUE RACK OR THE LIKE**—Primarily intended for supporting billiard cues but may be applied to gun racks, whip racks or other holding devices for supporting elongated articles in vertical position. Patent 1683533. T. Drost, c/o Wagner & Adler Co., 44 E. 14th St., New York, N. Y.

**LAMP-SHADE FRAME**—Of dual character, which will be useful optionally, in conjunction with either a drop lamp bulb or an upright lamp bulb. Patent 1683585. A. Lustig, c/o Idealistic Electric Lamp Shade Co., 34 E. 29th St., New York, N. Y.

**VANITY CASE**—Having a lid which is hingedly connected with a holding ring through a pentle structure integral with the ring, or independent thereof. Patent 1683551. W. G. Kendall, 118 Market St., Newark, N. J.

**WINDOW-CURTAIN FITTING**—Which will prevent dust accumulating on shade rollers, and provide a supporting means for the shade, and dust protector, so that either may be readily removed. Patent 1683568. V. H. Moody and C. W. Kempton, 19 Fairview Ave., Gloucester, Ohio.

**SOUND-ABSORBING SURFACE AND PROCESS OF PRODUCING SAME**—Which includes porous granular particles, and a gypsum base, that will prevent close packing and produce voids, for use on ceilings, walls and the like. Patent

not only were caught but were consumed by slow combustion and that the steel wool would not become fouled over a long period of use. He obtained another patent.

Between those two patents, however, another man, Foll, had obtained a patent, disclosing steel wool with a layer of asbestos to filter the fumes from a gas oven. Foll's patent was a plain anticipation of Koehler's second patent. The Koehler patent came into the possession of Akme Flue, Inc. The Aluminate Flexible Flue Cap Company, relying upon the Foll patent, began making and selling a similar flue. The former company sued the latter for infringement of Koehler's second patent. The District Court for the Eastern District of New York denied an injunction, holding that the patent was invalid, being anticipated by the Foll patent. The Circuit Court of Appeals, however, reversed the decision, Judge Swan saying:

"Koehler must rely upon his proof of discovery before March 13, 1922, the date of Foll's application. His testimony is that as the result of experiments with steel wool and asbestos filter mats, he learned by May, 1921, that the steel wool alone consumed the greases and was superior to steel wool and asbestos in contact. He sold his first patent, which discloses an asbestos filter, to Tyson and Frame in June, 1921, and then advised them to use the steel wool mat. There is ample corroborative oral testimony as to his use of steel wool in flues made in the spring of 1921.

"We are satisfied that upon this record the patent in suit is not shown to have been anticipated and should be held valid. The substitution of a known material has frequently been held to constitute invention."

### Figs and Nujol

**W**HEN the California Peach and Fig Growers Association of Fresno, California, sought to register the term "Nujol" as a trademark for dried figs, and the Standard Oil Company, of Bayonne, New Jersey, opposed the application as a violation of their prior use and registration of the term "Nujol" as a mineral oil, the Examiner of Interferences promptly dismissed the opposition.

Now at first glance, dried fruits and mineral oils have no more in common than have coffee and salad, over which the "Maxwell House" trademark controversy was waged. First Commissioner Kinnan thought differently, however. In overruling the Examiner, he held:

"It is apparent at once that the applicant has adopted the identical trademark alleged to have been adopted and used by the opposer continuously since a date long prior to the entrance of the applicant into the field, and the latter has used the mark upon one well-known kind of a laxative, while the opposer has used it upon another well-known kind. Both substances, the mineral oil and the figs, being used for the same purpose, this case is not so clear that the motion to dismiss should be granted.

"Furthermore, the allegation in the notice that the applicant uses the trademark upon figs treated with 'Nujol' brings the goods substantially within the class to which the opposer applies its mark. Mineral oil as a laxative and figs treated with mineral oil as a laxative constitute goods which would appear to possess the same descriptive properties."



1682986. L. B. Rymarczick, Los Angeles, Calif.

**CREAM SEPARATOR**—By means of which cream may be taken from milk in an ordinary milk bottle without touching the hands of the operator. Patent 1683882. J. A. Frisk, 3839 Roscoe St., Chicago, Ill.

**INDICATOR OR PROMPTER FOR HOUSEHOLD OR OTHER PURPOSES**—To be used as a reminder for the purchase of household articles, or other indicia, disclosing at a glance the matter to be called attention to. Patent 1684346. J. De-Bracht, c/o Juniata Crossing Hotel, Everett, Pa.

**DISPLAY STAND**—Formed of a standard and wire arms projecting laterally for supporting articles, the lower end of the arms having lugs for engaging the standard. Patent 1684340. R. O. Berke, c/o W. C. Nevin Candy Co., Box 566, Denver, Colo.

**BATH-CURTAIN SUPPORT**—For adjustably supporting a curtain over a bath tub, in position to surround the user, the device may be folded to occupy little space when not in use. Patent 1684284. H. Madison, 2017 So. 11th St., Council Bluffs, Iowa.

**STAIR COVERING APPARATUS**—Adapted to fit against the treads of the stairway and support independent floor covering sections, stairs can be easily covered or re-covered without skilled labor. Patent 1684328. C. M. Molinelli, 216 Beach 103 St., Rockaway Beach, L. I., N. Y.

**MEASURING AND DISPENSING DEVICE**—Adapted for use in connection with a receptacle containing sugar, or the like, permitting the user to dispense a teaspoonful, or any measure, as desired. Patent 1684313. R. V. Graham, Hill View and Aqueduct Ave., Yonkers, N. Y.

**HOLDER**—Comprising a pair of spring actuated clamping members and a pivotal connection, is quickly attachable and detachable, for adjustably holding flashlights, or other articles. Patent 1684347. A. S. Dobbs, 26 Redmond St., New Brunswick, N. J.

**CONDIMENT SET**—Inseparable, ornamental and insures positive results. For dispensing condiments, singly or simultaneously. Patent 1684623. Charles Hartwig, Hastings-on-Hudson, New York.

**BUILDING CONSTRUCTION**—A device by means of which suspension bars or rods for metal lath, or similar ceiling material, used in concrete ceilings, may be quickly applied. Patent 1684605. E. F. Tecemer, 2441 Sunnyside Ave., Chicago, Ill.

**SPACER**—Which may be formed from a single piece of wire of any desired length, for fastening together at right angles, reinforcing elements in concrete construction. Patent 1684051. F. W. Anderson, 413 Lynn St., Seattle, Wash.

**MAGAZINE BUFFER**—Of the reservoir type, designed to contain a substance to be applied and subsequently worked over a surface to polish or give a desired finish thereto. Patent 1685333. H. MacDougall and W. G. Kendall, 85 Oakland P.O., Maplewood, N. J.

**DISPENSING APPLICATOR**—For use in connection with hair tonics or the like, equipped with means for controlling the discharge and a series of massaging bits for applying the liquid. Patent 1685727. R. Stewart, 10914 108th St., Ozone Park, L. I., N. Y.

### Hardware and Tools

**ROTARY DRILL BIT**—Which is self sharpening, the cutters being hardened on the surface, so that as the softer material wears away it leaves a cutting edge constantly sharp. Patent 1683502. H. R. Tunnell, 2745 Edward St., Rutte, Mont.

**WEATHERPROOF-CONCEALED HINGE AND JAMB CONSTRUCTION**—For closures, such as casement windows and doors, which will be protected from the elements of weather, and exclude dust and dirt from the moving parts. Patent

1684323. J. Kubelka, 6217 Vincent St., Ridgewood, L. I., N. Y.

**WEATHERPROOF HINGE**—Enclosed in such a manner as to conceal and protect it from the effects of the elements and to prevent the elements passing the joint formed. Patent 1685002. V. J. Matraga, 852 Elizabeth Ave., Elizabeth, N. J.

**JACK**—Including a plurality of telescopically associated tubular sections, with means for introducing fluid under pressure for distending the jack, and means for collapsing the sections into nested relation. Patent 1685697. C. F. Guerin, c/o N. M. Guinsburg, 1 Liberty St., New York, N. Y.

**CLAMPS**—Which can be applied to or removed from the tubular sections of derrick legs, requiring relatively little time or labor in erecting or dismantling a derrick. Patent 1685696. G. Frank, Box 983, Wichita Falls, Texas.

### Heating and Lighting

**INTERCHANGEABLE SIGN ELEMENT**—Including a bulb and interengageable means, whereby the type of plugs desired for flood lighting, or penetrating illumination is facilitated, the device particularly applicable to signs. Patent 1683570. L. N. Moss, Cedarhurst, L. I., N. Y.

**GAS-HEATED STEAM RADIATOR**—By means of which substantially all the heat is radiated upwardly and outwardly, without danger of overheating the floor, or wall behind the radiator. Patent 1684371. J. F. Firth, 1169 Washington Ave., Bronx, N. Y.

### Machines and Mechanical Devices

**PULLEY ATTACHMENT**—For the carrying shaft of a grain thrasher, whereby the effective diameter will be increased, and the thrasher will be adapted for use as a pea or bean huller. Patent 1683562. C. Mackert, St. Anthony, Idaho.

**FILLING MECHANISM**—Which can be applied to a machine for filling a plurality of bottles, and has means for releasing any desired amount of air pressure from each bottle during the filling. Patent 1683677. J. Kantor, O. W. Fick and W. J. Traxel, c/o J. H. Pratt Liquid Carbonic Co., 3100 So. Kedzie Ave., Chicago, Ill.

**WINDOW-OPERATING MECHANISM**—By which sliding sashes can be manually operated to open and intermediate positions, and automatically locked either in closed or open position. Patent 1683914. F. J. Pfiffer, 1778 Evans Ave., Ventura, Calif.

**GRAIN-BIN FEED**—For application to a grain elevator of the usual type, to regulate the feed of grain from the dumping pit into the "leg" or upright casing. Patent 1684338. O. F. Aplin, Culbertson, Mont.

**INSTRUMENT FOR SURVEYING BORE HOLES**—By which the direction of the hole and its inclination with respect to the horizontal may be determined in a manner to enable the survey to be accurately computed. Patent 1684337. L. B. Wright, A. B. Yates and A. M. Leese, c/o Lawrence B. Wright, Lead, So. Dak.

**ROAD-BUILDING MACHINE**—Adapted to remove a predetermined depth of a road for producing a fine grading or planing of the roadbed preliminary to its treatment with a surface coating. Patent 1685687. H. F. Thompson, Stratford, N. Y.

**MACHINE FOR PAPER-MAKING PROCESSES**—Comprising a casing and a rotor which may be readily converted to be utilized as a knoter, silver screen, screen, pulp washer, thickener, filter, and save-all. Patent 1685736. H. D. Wells, 35½ Grant Ave., Glens Falls, N. Y.

**BRICK ICE-CREAM CUTTER**—Which is adjustable to cut ice cream into any desired number of sections, the support acting as a receiving member for the removal of the ice cream. Patent 1685700. C. A. Kulenkampf, 123 White St., New York, N. Y.

### Prime Movers and Their Accessories

**ENGINE EXHAUST**—Which operates to effect a thorough and instant removal of the burned gases, in such manner as to make the exhaust less objectionable. Patent 1685006. G. W. Schultz, Mertztown, Pa.

**MUFFLER**—Adapted to break up the exhaust gases into fine streams, thus cooling and causing a uniform flow, and less noise when the gases are expelled. Patent 1685302. H. E. Tyler, 2818 N. Fairfield Ave., Chicago, Ill.

### Pertaining to Recreation

**AQUATIC AMUSEMENT DEVICE**—Provided with buoyant elements for supporting an operator in the water, with means whereby he may propel and steer himself. Patent 1683058. H. Uberto, 2464 4th Ave., Astoria, L. I., N. Y.

**GOLF BLINDERS**—Through which a player may properly observe the ball and a limited area around it, when driving, but may have such vision as is desired after the drive. Patent 1683505. N. S. Walker, 71 Broadway, New York, N. Y.

**SKI HANDLE**—A substantially arc-shaped handle which will provide means whereby the same may be conveniently grasped by either a tall or short person. Patent 1684326. A. E. Martinson, 85 Poplar Ave., Silver Beach Garden, Bronx, N. Y.

### Pertaining to Vehicles

**TANK GAUGE**—Adapted to be applied to a gasoline tank for accurately indicating at a distance from the tank the quantity of liquid therein at any given time. Patent 1683557. C. F. Kokemiller, R. No. 1, Box 361, Story City, Iowa.

**METHOD OF DAMPING OSCILLATIONS FOR USE WITH SUSPENSION LEAF SPRINGS AND THE LIKE**—Which consists in creating between the leaves an elastic friction of an intensity which may be regulated to oppose oscillations, and thus obtain a very smooth suspension. Patent 1683522. F. L. Broussous, c/o Office Pickard, 97 Rue St. Lazare, Paris, France.

**COMBINED LOCKING DEVICE AND SEAL**—By which the usual couplings for connecting a speedometer head and a driving element can be securely locked and sealed against tampering. Patent 1683932. A. D. Summers, 332 Witmer St., Los Angeles, Calif.

**TIRE-PRESSURE INDICATOR**—Which will visibly indicate by different signals to the driver of a vehicle, while the car is in motion, whether the tires are properly inflated. Patent 1683343. J. H. Gartner, 150 Sequoia Drive, San Anselmo, Cal.

**SAFETY BUMPER**—In which the members which actually contact with a person struck are made of flexible material, quickly giving and thus reducing the shock. Patent 1683283. H. M. Bowman, 134 Bryant St., Mountain View, Calif.

**DEVICE FOR INSPECTING TIRES**—A supporting device for facilitating the handling of tires and outer casings, when it is desired to inspect the exterior or interior surfaces for punctures or imperfections. Patent 1685038. M. Teich, 103 North Division St., Peekskill, N. Y.

**ATTACHMENT OF MOTOR-VEHICLE ROAD SPRINGS**—Applicable to springs which are hinged attached, the bearing surfaces being formed somewhat flattened in V-shaped cross section, whereby sidewise movement and rattle are prevented. Patent 1685005. D. Robertson, c/o Collision & Co., 483 Collins St., Melbourne, Australia.

**HIGH-SPEED TRANSPORTATION SYSTEM**—A vehicle having the advantages of an aeroplane and an electric car, operated safely upon elevated tracks, thus avoiding the anxiety caused by high flight. Patent 1685035. W. E. Robertson, 412 Washington St., Reading, Pa.

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Lack of space makes it impossible to give many cross-references or to enter a given reference in more than one place. Each article is therefore entered where it is believed it will be most easily found. In every case, the general subject should be sought rather than the supposed specific title of an article. We call special attention to the classifications "Aviation," "Household," "Medicine," "Radio," etc., under which many items will be found whose location otherwise would be very puzzling. The asterisk (\*) indicates that the article in question is illustrated.

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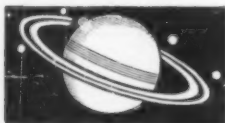
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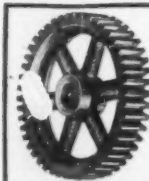
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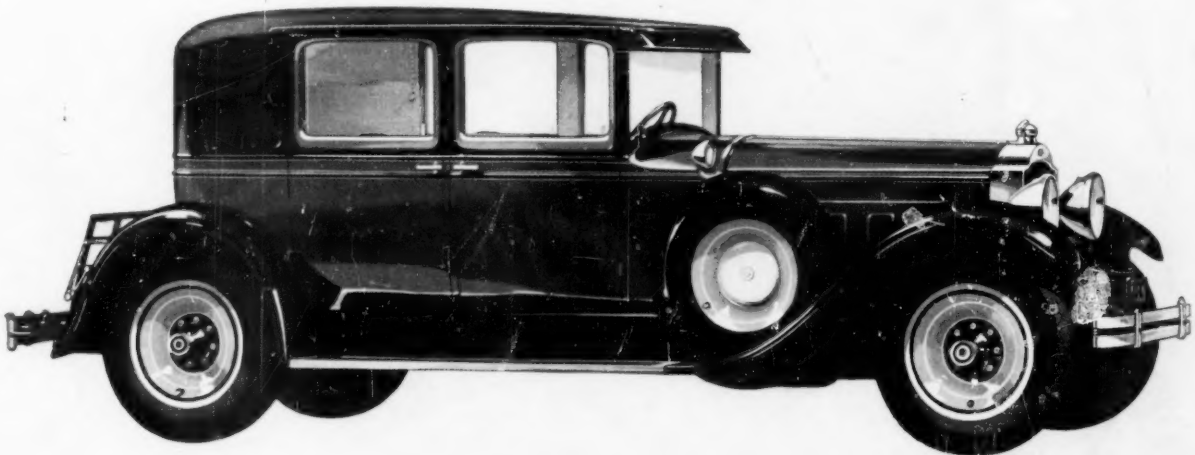
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